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Regulated and Unregulated Exhaust Emissions from a Malfunctioning Three-Way Catalyst Gasoline Automobile

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San Antonio, TX

Prepared for

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REGULATED AND UNREGULATED EXHAUST EMISSIONS FROM A MALFUNCTIONING THREE-WAY CATALYST GASOLINE AUTOMOBILE

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Prepared for

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Office of Air, Noise and Radiation
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Emission Control Technology Division
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January 1980

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Publication No. EPA-460/3-80-005

ABSTRACT

This report describes the laboratory effort to characterize regulated and unregulated exhaust emissions from a current model three-way catalyst-equipped gasoline automobile operating under malfunction conditions. One automobile was evaluated over three driving schedules in the unmodified configuration and in four engine and/or emission control system malfunction configurations. Exhaust emission constituents measured, in addition to the currently regulated emissions, include: particulates, sulfates, aldehydes, sulfides, amines, metals and several additional elements and compounds. Additional evaluations, in each of the configurations, involved the measurement of the regulated emissions over four short-test procedures.

FOREWORD

This project was initiated by the Technology Assessment and Evaluation Branch, Environmental Protection Agency, 2565 Plymouth Road, Ann Arbor, Michigan 48105. The engineering and analytical effort on which this report is based was accomplished by the Department of Emissions Research of Southwest Research Institute, 6220 Culebra Road, San Antonio, Texas 78284. This project, authorized by Contract 68-03-2692, was initiated on August 21, 1978, and was completed November 21, 1979.

The SwRI Project Leader was Mr. Charles Urban who supervised all vehicle testing, data analyses and reporting. Mr. Harry Dietzmann was in charge of all unregulated emissions procedural development related activities that were involved in this project. Mr. Karl Springer was Project Manager and was involved in the initial technical and fiscal negotiations and all subsequent major project decisions.

The Project Officer throughout the entire project was Mr. Robert Garbe of the Technology Assessment and Evaluation Branch, Environmental Protection Agency. Mr. Garbe played an active part in several project areas. Dr. Ronald Bradow and members of his staff, of the Environmental Protection Agency at Research Triangle Park in North Carolina, provided considerable technical and other support relative to the analyses of the unregulated emissions.

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SUMMARY

The major objective of this project was to study exhaust emissions from a current model low-NO_x, catalyst-equipped gasoline automobile operating under malfunction conditions. These evaluations involved analyzing the exhaust for many unregulated compounds and elements in addition to the currently regulated emissions.

This study involved one automobile; a 1979 Mercury Marquis with a 351-CID engine. This automobile was certified to the Federal emissions standards and utilized a catalytic converter with feed-back carburetion. The catalytic converter contained a three-way catalyst followed by an oxidation catalyst, with additional air supplied between the two catalysts. Following final selection of the malfunction conditions, the automobile was evaluated in the unmodified (tuned-up to manufacturer's specifications) and in four different malfunction configurations. Malfunction conditions evaluated in the vehicle testing phase were disconnected oxygen sensor, twelve percent ignition misfire with the air to bypass, disconnected EGR sensor with air to bypass, and disconnected cold temperature sensor.

Unregulated emission compounds measured included: sulfates, particulates, metals and other elements, aldehydes, cyanides, sulfides, organic amines, nickel carbonyl, n-nitrosodimethylamine, ammonia and nitrous oxide. A number of the analytical procedures for these compounds were developed specifically for use in this and several other related projects.

The three primary test sequences involved in this project were the light-duty Federal Test Procedure (FTP), the congested freeway driving schedule and the highway fuel economy driving schedule. In addition, the regulated emissions were evaluated over the New York City Cycle, the Federal Short Cycle and two steady-state procedures. The basic requirements specified in the Code of Federal Regulations for certification of light-duty vehicles were followed for the three primary test sequences and the two additional driving cycles.

A significant data base on the car evaluated, for both regulated and unregulated emissions, was generated in this project. These data were analyzed to the extent applicable and are presented in several different formats to facilitate their review and usage. Highest values detected, for the car operating under the three primary test cycles in all configurations evaluated, are summarized as follows:

Emission	Emission Rate, mg/km Unmodified	 Malfunction
Hydrocarbons[a]	130	1800
Carbon Monoxide[a]	1600	52400
Oxides of Nitrogen[a]	830	2500
Total Particulates[a]	2	11
Sulfate	27	5
Aldehydes & Ketones	3	3
Organic Sulfides	<1	1
Organic Amines	0.0	<0.1
Ammonia	5	253
Cyanides & Cyanogen	<1	112
Hydrogen Sulfide	0	3
Nickel Carbonyl	0.00	0.00
Nitrous Oxide	24	88

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[a] Values for the FTP are given for the three regulated emissions and total particulates. For HC, CO and NO_x, the FTP values were the maximum values.

I. INTRODUCTION

This report describes the effort to characterize regulated and unregulated exhaust emissions from a current model, three-way catalyst-equipped, gasoline automobile operating in the unmodified and under malfunction conditions. This is the third project to be completed from among several related projects at SwRI involving the evaluation of a large number of unregulated emissions from gasoline automobiles. The initial projects involved evaluation of non-catalyst, oxidation catalyst and three-way catalyst gasoline automobiles.(1,2)*

A. Project Objective

The major objective of this project was to evaluate the effects of engine malfunction conditions on exhaust emissions from a current model, three-way catalyst-equipped, automobile. Emissions evaluated included the three currently regulated emissions (HC, CO, and NO_x) along with a significant number of currently unregulated compounds (e.g., sulfates, sulfides, aldehydes, amines, etc.).

B. Emissions Measurement Procedures

The emissions measurement procedures utilized in this project ranged from those procedures routinely used (HC, CO, NO_x, sulfate, etc.) to procedures that required considerable research and experimentation before they became operational (organic sulfides, amines, etc.). The compounds or compound groups evaluated, along with the sampling methods used, were as follows:

Sampling Method	Compounds Evaluated
Bag	HC, CO, NO_x, CO_2, Individual HC, Nitrous Oxide and Nickel Carbonyl
Filter	Sulfates, Particulates, Metals, and other Elements
Impinger	Cyanides, Aldehydes, Hydrogen Sulfide, Ammonia and Organic Amines
Trap	Carbonyl Sulfide, Organic Sulfide, and DMNA

A number of the procedures for measuring unregulated emissions were developed in another project and reported in a widely distributed interim report.(3)

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* Superscript numbers in parentheses designate references at end of report.

C. Vehicles Evaluated

One automobile was utilized in this project, a 1979 Mercury Marquis, with a 351-CID engine, certified for sale in the 49 states (excluding California). This car had feedback carburetion and also had EGR. The catalytic converter consisted of a three-way catalyst followed by an oxidation catalyst, with additional air introduced between the catalysts.

D. Malfunction Conditions Evaluated

The automobile was evaluated in the unmodified configuration (i.e., tuned-up to manufacturer's specifications) and under various malfunction conditions. Potential malfunction conditions for this project were identified from the service manual, discussion with a representative from the manufacturer and the previous malfunction projects.(1,2) A series of tests were then conducted to identify the "best" malfunction candidates for use in this project. Malfunction conditions initially considered were: disabled oxygen sensor, rich operation, engine misfire, EGR failure, air system failure, high oil consumption, extreme lean operation and various combinations. Leaded fuel operation was not chosen for consideration due to lack of emission measurement methods for halogen compounds at the time this project was initiated. Therefore, the use of leaded fuel remains as an undetermined potential area of concern. High oil consumption was not chosen as a candidate malfunction since high oil consumption received considerable coverage in the preceeding malfunction projects. Extreme lean operation was not selected as a candidate malfunction since it had been found to produce unacceptable driveability in the previous projects. All of the candidate malfunction conditions were evaluated in either the malfunction screening or the vehicle testing phases of this project.

E. Vehicle Testing

The automobile involved in this study was tested in the unmodified configuration (i.e., tuned-up to manufacturer's specifications) and in each of four malfunction conditions. The test sequence included the Light-Duty Federal Test Procedure (FTP)(4), the Congested Freeway Driving Schedule (SET)(5), and the Highway Fuel Economy Driving Schedule (HFET).(6) Preconditioning of the vehicle prior to testing was conducted in accordance with the 55 mph Alternate Mileage Accumulation Procedure.(7) To the extent practical, all specified unregulated exhaust constituents were sampled and analyzed during every test. In addition, the regulated emissions were measured in each configuration using four short-test procedures.

II. GENERAL EQUIPMENT, INSTRUMENTS, PREPARATION AND PROCEDURES

This section describes the vehicle, the fuel and lubricant, the facilities and the general instrumentation and procedures utilized in this project. The overall sampling systems for the unregulated emissions are also discussed.

A. Vehicle

One new, gasoline-powered automobile was evaluated in this project. This automobile (car) is described in Table 1 and is shown in subsequent Figure 2. The car was leased from a local San Antonio leasing agency and came equipped with the normally obtained options, such as automatic transmission and steel-belted radial tires. This car came equipped with the standard rear-axle ratio and standard size tires.

TABLE 1. DESCRIPTION OF THE AUTOMOBILE EVALUATED

Vehicle					
Year	Make	Model	Body Type	ID or Serial Number	GVWR, kg
1979	Mercury	Marquis	4-dr	92662H637731	2435

Engine		Emission Controls		
CID/Cyl	Family	Catalyst	Air Pump	EGR
351/8	5.8WBV2TT95x95	3-way+Oxi.[a]	Yes	Yes

Fuel Control System		Chassis Dynamometer Settings[b]	
Fuel Control	Oxygen Sensor	Inertia, kg (lbs.)	Power, kw (hp)[c]
Feed-back carb.	Yes	2040 (4500)	8.9 (12.0)

Note: Automobile was equipped with automatic transmission, air conditioning, and steel-belted radial tires

---

[a] Three-way catalyst followed by an oxidation catalyst
[b] Same as setting used in EPA certification of the automobile
[c] Includes the increase for air conditioning

B. Fuel and Lubricant

Throughout this project a single batch of Chevron UL-CQ26B1 unleaded gasoline, the type provided to auto manufacturers for emissions durability tests, was used for all testing. This gasoline, described in Table 2, was made in accordance with the specifications outlined in MSAPC Advisory Circular No. A/C 25B1 and contained no measurable manganese. The hydrogen to carbon ratio was 1.89 and the SwRI identification number was EM-344.

The engine lubricant used throughout this project was Exxon Uniflow 10W40 motor oil. This motor oil, in addition to having a significant sales volume, contained an additive for reducing engine friction. Indications at the time this motor oil was initially selected were that many or most major motor oil manufacturers were planning to incorporate friction additives into their motor oils.

C. Dynamometer and CVS System

A Clayton Model ECE-50 chassis dynamometer with a belt-driven variable-inertia flywheel system, was utilized for all transient testing. The belt-driven inertia system simulates equivalent weight of vehicles from 680 kg (1500 lbs) to 2495 kg (5500 lbs) in 115 kg (250 lb) increments to 1360 kg and 225 kg increments above 1360 kg.

The constant volume sampler (CVS) used for these evaluations was SwRI CVS Number 2. This unit has a nominal capacity of 9.2 m^3/min (325 cfm). A nominal 460 mm (18 inch) diameter by 5 m (16 feet) long dilution tunnel was used between the intake filter and the CVS to enable sampling of sulfates and particulates.

Partial views of the chassis dynamometer, the dilution tunnel and the intake to the CVS can be seen in subsequent Figure 2. Both the dynamometer and the CVS were calibrated, maintained and operated in accordance with the manufacturer's instructions and the appropriate sections of the Code of Federal Regulations applicable to light-duty vehicles.(4)

In addition to the 142 m^3/min (5000 cfm) cooling fan placed in front of the automobile, 42 m^3/min (1500 cfm) blowers were available to cool each rear wheel and to blow the heat from the exhaust pipe away from the automobile's gasoline tank. These additional blowers were used only during the SET and HFET driving cycles.

D. Exhaust Sampling and Analysis

A pictorial schematic of the exhaust and sampling system is shown in Figure 1. This system is in accordance with the guidelines established in various projects conducted at SwRI for the EPA. The major difference between this system and similar systems used in other projects is the number of sampling probes and systems required to collect all of the required unregulated emission samples. This is illustrated in the several views of the system shown in Figure 2. View A shows an overall view of the entire system in operation during an

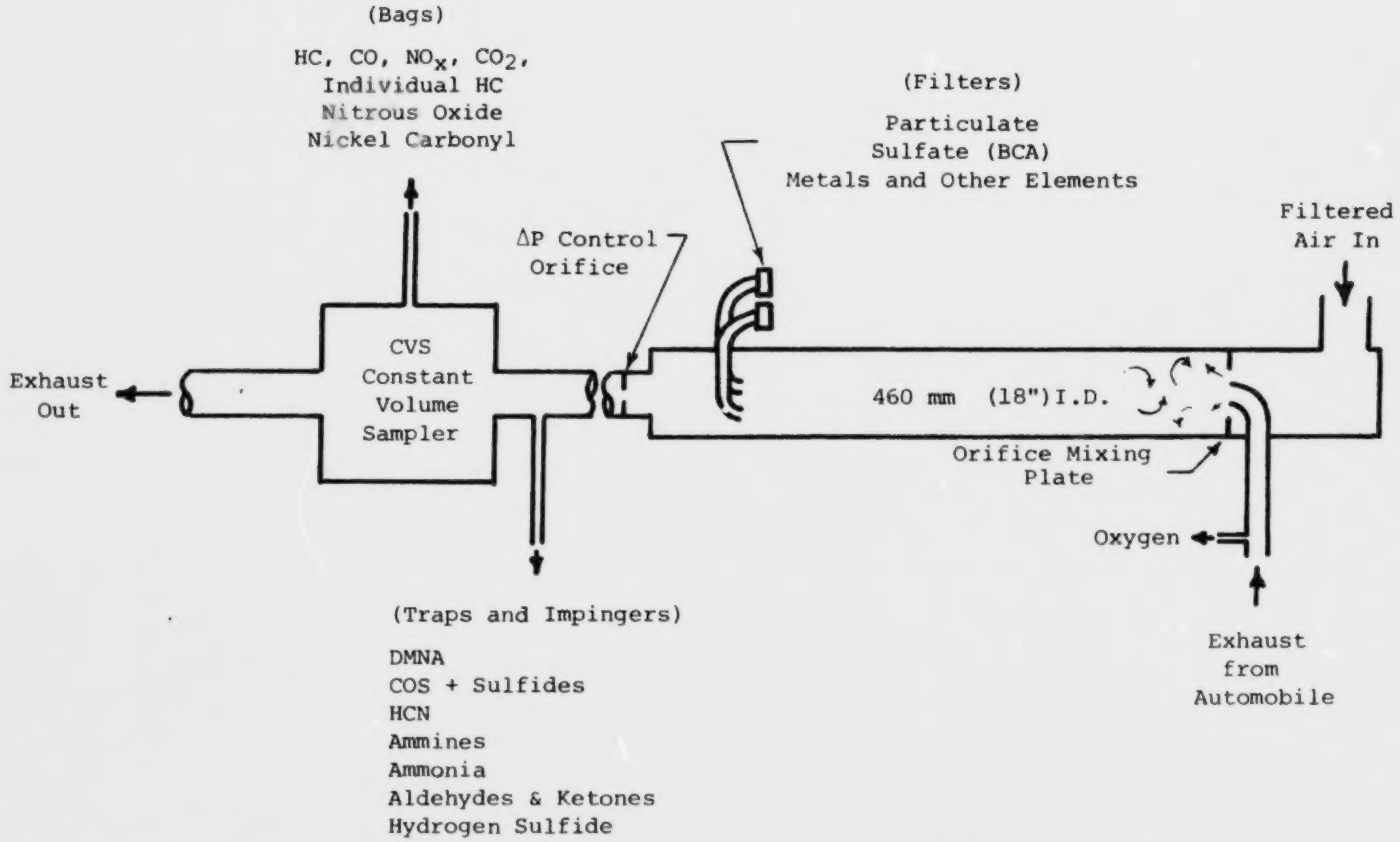
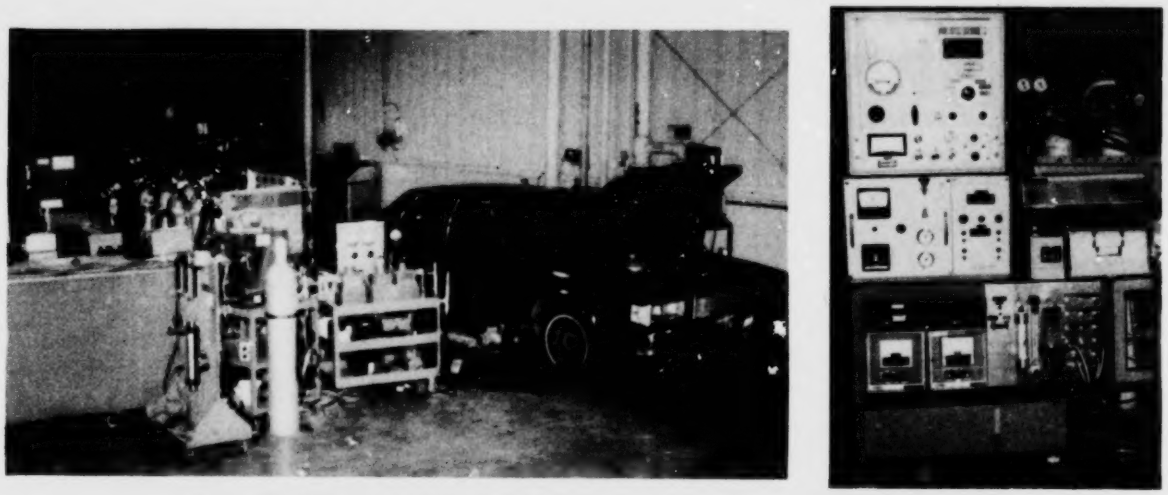
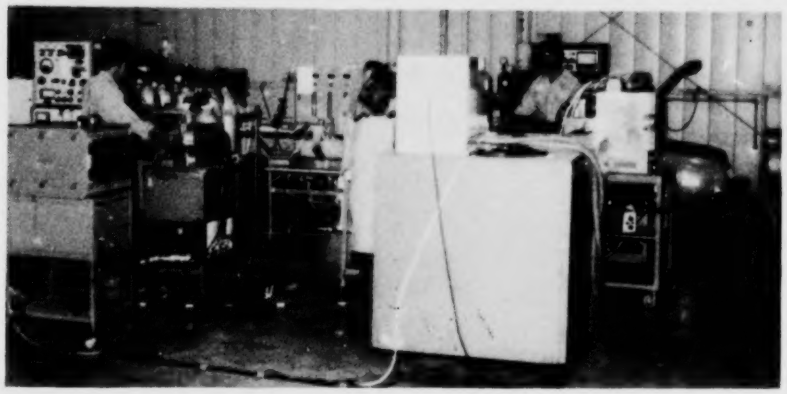

(Bags)
HC, CO, NO_x, CO_2,
Individual HC
Nitrous Oxide
Nickel Carbonyl
(Filters)
Particulate
Sulfate (BCA)
Metals and Other Elements
Filtered
Air In
ΔP Control
Orifice
Exhaust
Out
CVS
Constant
Volume
Sampler
460 mm (18")I.D.
Orifice Mixing
Plate
Oxygen
Exhaust
from
Automobile
(Traps and Impingers)
DMNA
COS + Sulfides
HCN
Ammines
Ammonia
Aldehydes & Ketones
Hydrogen Sulfide

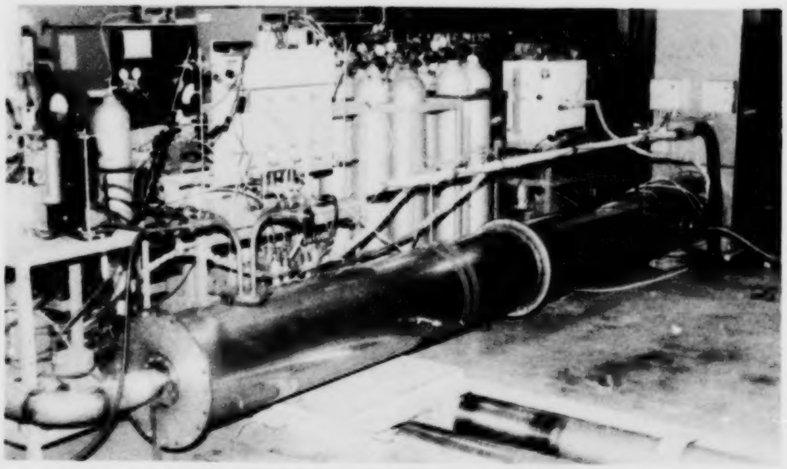
Figure 1. Gasoline engine emissions sampling system



A. Entire Sampling System B. Regulated Emissions



C. CVS Side of System



D. Dynamometer Side of System

Figure 2. Views of the emissions sampling system

TABLE 2. DESCRIPTION OF CHEVRON UL-CQ26B1 UNLEADED GASOLINE

	Test Method	
Availability Date		April 24, 1978
Tank No.		94
Gallons		801,901
Gravity, °API at 60°F	ASTM D 1298	58.4
Research Octane No.	ASTM D 2699	91.6
Motor Octane No.	ASTM D 2700	83.2
Sensitivity		8.4
Lead, g/Gal.	ASTM D 3237	0.001
Sulfur, Wt %	X-Ray - ASTM D 2622 (Modified)	0.029
Phosphorus, g/Gal.	ASTM D 3231	0.0002
Manganese, g/Gal.	EAM 128-74	0.001
Gum, mg/100 mℓ	ASTM D 381	
Unwashed		85
Washed		0
Reid Vapor Pressure, psi	ASTM D 323	8.9
Distillation, °F (% Evaporated)	ASTM D 86	
IBP		97
10%		129
50%		212
90%		328
EP		386
Recovery, %		97.5
Residue, %		1.0
Loss, %		1.5
Acidity of Residue	ASTM D 1093	Pass
Hydrocarbons, Vol. %	ASTM D 1319	
Aromatics		28
Olefins		8
Saturates		64
Benzene, Vol. %	Chevron Research Technique	2.0
Water and Sediment, Vol. %	ASTM D 2709	<0.001
Oxidation Stability, Hr.	ASTM D 525	24+
Copper Corrosion	ASTM D 130	1A

Note: These inspection data were provided by the Chevron Research Company.

actual test. View B shows the system used to continuously record the dilute HC, CO, NO_x, and CO_2, the O_2 in raw exhaust, and the catalyst temperature. Views C and D show a significant portion of the sampling systems for the unregulated emissions.

This section has described the dilution tunnel and provided some insight into the overall sampling system assembly. More details on each of the individual sampling systems for the unregulated emissions are given in Section III of this final report.

E. Instrumentation for Regulated Emissions and Engine Parameters

Bagged samples of the dilute exhaust were evaluated for HC, CO, NO_x, and CO_2 using SwRI Bag Cart Number 1. This bag cart was designed, calibrated and operated in accordance with the appropriate sections of the Code of Federal Regulations applicable to light-duty vehicles.(4)

In addition, the levels of dilute HC, CO, NO_x and CO_2 were recorded continuously on a strip chart recorder. These dilute emissions are automatically engine exhaust flow-weighted, and provide a better insight into variability of mass emissions during cyclic procedures than would be provided by continuous direct emission measurement. Other items continuously recorded were the vehicle speed, the oxygen level in the undiluted exhaust and the catalyst exit temperature. The instrumentation used for these continuously recorded data were as follows:

Parameter Measured	Instrument or Method		
	Type	Make & Model	Ranges Used
HC	FID	SwRI No. 007	100 through 3200 ppm
CO	NDIR	Beckman 315B	0.3, 0.6 & 1.5%
NO_x	CL	Thermo Electron 12A	100 & 1000 ppm
CO_2	NDIR	Beckman 315B	6%
O_2	Polarographic	Beckman 715	5 & 25%
Temp.	Thermocouple		
Speed	Parallel output from the Dynamometer Controls		

These continuously recorded data were used for obtaining the catalyst maximum temperature and in helping to resolve any problems or questions occurring with the other test data. In addition, these data remain available in the event they may be useful in clarifying future findings.

The catalyst average temperature and the average oxygen level in the undiluted exhaust were obtained using Acromag 1324-LY-1 integrators. The average oxygen level (and to some extent the catalyst temperatures) was determined to have only a gross relative meaning for most of these evaluations. Oftentimes, the oxygen level was relatively high when the exhaust flow was low (e.g., idle and cut-throttle) and relatively low when the exhaust flow was relatively high (e.g., highway speed). The integration of the oxygen in the undiluted exhaust does not compensate for these changes in exhaust flow. It is possible to have a significant average oxygen level and yet be deficient in oxygen over some portions of the driving cycle. Therefore, the average oxygen level serves only as a general indicator of the malfunction condition (e.g., average oxygen level decreases somewhat for rich operation). Catalyst temperatures were effected by the placement of the thermocouples and the cooling fans.

F. Emissions Test and Mileage Accumulation Procedures

The primary procedures and driving schedules utilized in this project are defined as follows:

FTP - 1979 Federal Test Procedure(4) (uses the Urban Dynamometer Driving Schedule)

SET - Congested Freeway Driving Schedule(5)

HFET - Highway Fuel Economy Driving Schedule(6)

MDDS - Modified Durability Driving Schedule(7) (with all WOT Accelerations changed to normal Accelerations). This procedure is described in Appendix A-1.

Each of the three primary procedures and schedules, requiring emissions testing in this project (FTP, SET and HFET), utilized bagged samples for evaluation of regulated emissions and fuel consumption. In addition, evaluation of the regulated emissions were conducted using several short-test procedures. These short-test procedures are discussed in Section II.H.

The SET and the HFET are both hot-start, single-segment driving cycles. The FTP, however, involves cold-start and hot-start, multi-cycle with multi-segment operation. In addition, in this project, a four-bag FTP was utilized for most of the unregulated emissions; rather than the three-bag FTP specified in the Federal Test Procedure. Therefore, before proceding, it is important to clarify the meaning of FTP as used in this project:

FTP - The FTP uses the Urban Dynamometer Driving Schedule (UDDS) which is 1372 seconds in duration. The UDDS, in turn, is divided into two segments; the first having 505 seconds and the second having 867 seconds. The Federal Test Procedure consists of a cold-start 505 and a stabilized 867 followed by a hot-start 505. In this project, the hot 505 was followed by another 867 segment. For the remainder of this discussion, and throughout this report, the four-cycle FTP will be identified as presented on the following page. Therefore, with the assumption that the changes in distance traveled are negligible, the composite results with the four-cycle FTP relative to results with the three-cycle FTP will differ only as the mass emissions emitted during Cycle 4 differ from that emitted during Cycle 2. An assumption made, that the overall effect of such differences were relatively minor, was validated in the Task 1 evaluations under EPA Contract 68-03-2499.

The test sequence followed for each automobile is given in Table 3.

	Four-Cycle FTP			
	Cold UDDS		Hot UDDS	
Cycle	1	2	3	4
Duration, seconds	505	867	505	867
Regulated Emissions, 3-Bag	X	X	X	
Regulated Emissions, 4-Bag	X	X	X	X
Unregulated Emissions:				
Bag	X	X	X	X
Impinger	X		X	
Trap (Except DMNA)	X		X	
Trap DMNA	X			

NOTE: X designates a sample taken

A composite value in mass per distance for the three-cycle, three sample FTP regulated emissions is calculated using the following formula:

$$\frac{\text{MASS}}{\text{DISTANCE}} = \frac{0.43 \times (\text{MASS 1} + \text{MASS 2}) + 0.57 \times (\text{MASS 3} + \text{MASS 2})}{0.43 \times (\text{DIST. 1} + \text{DIST. 2}) + 0.57 \times (\text{DIST. 3} + \text{DIST. 2})}$$

Assuming Distance 3 is equal to Distance 1, this equation can be reduced to:

$$\text{3-FTP M/D} \simeq \frac{0.43 \times (M1 + M2) + 0.57 \times (M3 + M2)}{D1 + D2}$$

For the four-cycle FTP, two sample, composite values determined in this project, the following formula was used:

$$\frac{\text{MASS}}{\text{DISTANCE}} = \frac{0.43 \times M(1 + 2) + 0.57 \times M(3 + 4)}{0.43 \times (D1 + D2) + 0.57 \times (D3 + D4)}$$

Assuming Distance 3 is equal to Distance 1 and Distance 4 is equal to Distance 2, then this equation can be reduced to:

$$\text{4-FTP M/D} \simeq \frac{0.43 \times M(1 + 2) + 0.57 \times M(3 + 4)}{D1 + D2}$$

TABLE 3. TEST SEQUENCE FOR EACH MALFUNCTION

Sequence	Operation Performed on Vehicle
upon receipt	Tune-up to manufacturer's specifications.
1	Precondition for 1600 km (995 mi) using the MDDS
2	Run FTP, SET, HFET - Sample and analyze applicable Task 2 compounds.
3	Precondition for 200 km (125 mi) using the MDDS
4	Modify to operate in a Task 1 malfunction condition.
5	Precondition for 100 km (62 mi) using the MDDS
6	Run FTP, SET, HFET: FTP, SET, HFET - Sample and analyze applicable Task 2 compounds.
7	Run Short Cycle Procedures.
8	Collect Pallflex filter sample over three FTP cycles (6 each UDDS).
9	Return to unmodified condition, replace the catalyst, and tune-up to manufacturer's specifications.

FTP - Federal Test Procedure

SET - Congested Freeway Driving Schedule

HFET - Highway Fuel Economy Driving Schedule

MDDS - Modified Durability Driving Schedule

Sequences 1 through 7 were repeated for each of four malfunction conditions on each automobile. The sequence followed in the laboratory for running one set of emissions tests (FTP, SET and HFET) is given in Table 4.

The parameters of the three primary driving schedules, along with the two short-test driving cycles, are summarized in Table 5 and these schedules are illustrated in Figure 3. Other driving schedule designations frequently used are as follows:

Driving Schedule Designation Used	Other Common Designations
FTP	LA-4 and UDDS
SET	CFDS and SET-7
HFET	FET
NYCC	SET-8

G. Test Numbering System

The numbering system, established for the various related unregulated emissions projects being conducted at this laboratory, consist of six digits. One of the digits was not required for this project so a dash (-) was used in its place. The designation used for all vehicle testing, subsequent to the malfunction screening evaluation, was PVM-ST. The meaning of each letter or group of letters is described as follows:

	Description	As used for this project
PV	Vehicle Designation	
	P Project	5
	V Vehicle	1
M-	Condition Tested	
	M Malfunction	1 through 4
	- Space not used in this project	-
S	Test Series (Unmodified or Malfunction	1 through 3
T	Individual Test (FTP, SET or HFET)	1 through 3
	(NYCC, FSC, TSIT or FTM)	4 through 7

The PV is used to identify the vehicle tested

In this project, the test condition is sufficiently identified by one digit so the M, followed by a dash (-), was used to identify the specific malfunction conditions.

The S designates the test series (FTP, SET, HFET) where:
1 = Unomdified vehicle
2 & 3 = Initial and repeat test in a malfunction configuration

The T designates the individual test conducted where:
1 - FTP, 2 = SET and 3 = HFET

TABLE 4. LABORATORY TEST SEQUENCE

1. Precondition, UDDS

2. Soak 12 to 20 hours

3. FTP - 4 bags for gaseous emissions
   2 filter or impinger samples

4. Soak 20 minutes - Fan Off

5. Precondition first 505 seconds of UDDS

5. Idle 1 minutes (± 15 seconds)

   (a) auto. trans. - drive
   (b) start additional cooling blowers
   (c) place filter holder in tunnel

7. SET - 1 bag sample
   1 filter or impinger sample

8. Engine Off - 10 minutes - Fan Off

9. HFET - 1 bag sample
   1 filter or impinger sample

NOTE: 5000 cfm fan on during all car operation. Additional tire and fuel tank cooling blowers on during all SET and HFET operation.

TABLE 5. SUMMARY OF DRIVING SCHEDULE PARAMETERS

		Duration, Seconds	Distance, Kilometers	Average Speed	
				km/hr	mph
FTP:					
	505	505	5.8	--	--
	867	867	6.2	--	--
	UDDS	1372	12.0	31.4	19.5
SET		1398	21.7	56.0	34.8
HFET		765	16.5	77.6	48.2
Short-Cycle Procedures					
NYCC		599	1.91	11.5	7.1
FSC		125	1.21	34.9	21.7

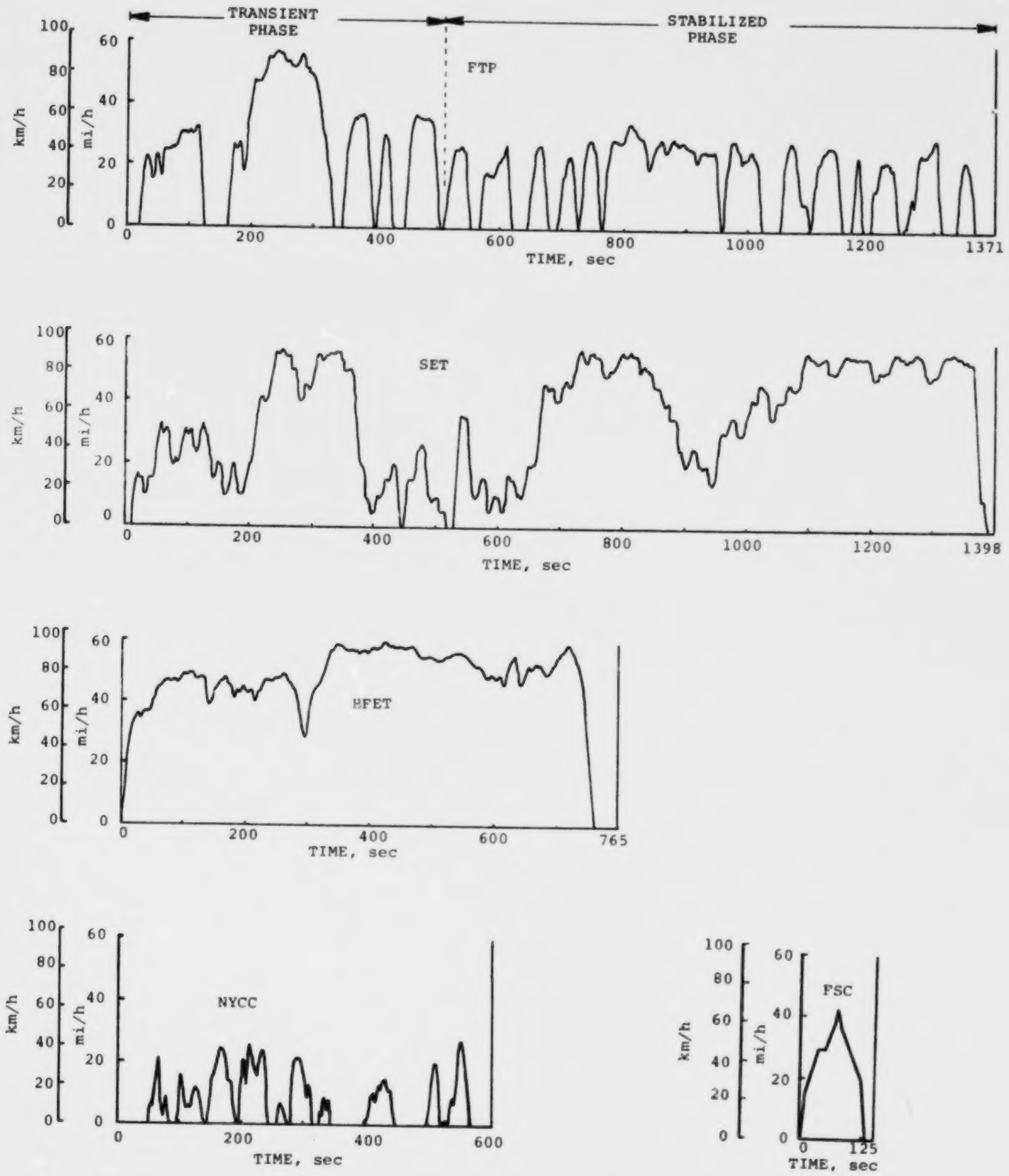


Figure 3. Driving cycle speed vs time traces.

H. Short-Test Procedures

Regulated emissions were also evaluated over four short-test procedures. These procedures, described in Appendix A-2, are defined as follows:

NYCC - New York City Cycle

FSC - Federal Short Cycle

TSIT - Two Speed Idle Test

FTM - Federal Three Mode

The parameters for the NYCC and the FSC were given in previous Table 5 and the schedules were illustrated in Figure 3. All of these short-test procedures are conducted with the engine in a warmed-up operating condition. The NYCC involves a lot of idle and low-speed operation and has an average speed of only about one-third that of the FTP. Emissions evaluations with the two driving cycles involved bagged samples of CVS diluted exhaust.

The TSIT and FTM are steady-state procedures involving measurement of the concentrations of HC, CO, and NO in the raw exhaust. HC was measured by nondispersive infrared in units of ppm hexane. Nitric oxide was measured using a chemiluminescence analyzer, without the sample going through the converter. Measurement of NO rather than NO_x was specified. Also, with high concentrations of carbon monoxide and/or hydrocarbons in the exhaust, passage through the converter generally results in erroneous values for oxides of nitrogen. This factor has been well documented and reported in a number of previous projects.

The operating sequence followed for the short-test procedures is given in Table 6. Specified instrument ranges, for the undiluted emissions measured during steady-state evaluations were as follows:

HC - 0-100 or 0-200 and 0-2000 ppm (Hexane)

CO - 0-0.5% and 0-10%

NO - 0-100, 0-1000, 0-2500 and 0-4000

Ranges as near as practical to these specified ranges were used.

I. Pallflex Filter Samples

Upon completion of a malfunction test series, a 20-cm by 25-cm (8" x 10") Type T60A20 Pallflex filter sample of diluted exhaust was taken for BaP and possible bioassay analyses at the EPA. The Pallflex filter samples were taken using a high-volume sampling system with a nominal sample flow rate of 0.85 standard m^3/min (30 scfm). The 8.9-cm (3.5-inch) inside diameter sampling probe required the use of an 18-inch diameter dilution tunnel. Available CVS flow rates for use in these evaluations were 9 and 14 standard m^3/min (300 and 500 scfm). A flow rate was selected which would keep the sample temperature at the Pallflex filter below 43°C (110°F).

TABLE 6. SEQUENCE FOR SHORT-TEST PROCEDURES

DILUTE EMISSIONS TESTING - CVS

1. Check Inertia and Horsepower (Use same values as for FTP)
2. Run 505 Seconds of the FTP
3. Idle 6 minutes in Neutral with Fan On
4. RUN (NYCC) & COLLECT BAG
5. Idle 6 minutes in Neutral with Fan On
6. RUN (FSC) & COLLECT BAG - Use 1 CFM High Volume Sampler

RAW EMISSIONS TESTING - HC AND CO BY NDIR, NO OR NO_x BY CL

7. Idle 6 minutes in Neutral with Fan On
8. RUN TWO SPEED IDLE TEST (TSIT) - Three minutes per mode
   a. 2500 rpm in Neutral - measure during minutes 2 through 3
   b. Normal Idle in Neutral - measure during minutes 2 through 3
9. Continue Normal Idle for 6 minutes Total
10. Set Inertia at 1750 pounds (795 kg)
11. RUN FEDERAL THREE MODE (FTM)

Minute 1 - Set 18.0* Horsepower at 52 mph (84/km/h)
2 - Stabilize
3 - Measure Emissions

Minute 4 - Set 9.5* Horsepower at 25 mph (40 km/h)
5 - Stabilize
6 - Measure Emissions

Minute 7 - Idle in Neutral
8 - Stabilize
9 - Measure Emissions

*Dynamometer horsepower setting as determined from a special chart provided (Based on NADA weight + 181 kg (400 lbs.))

The same filter was used throughout a cold-start 12-bag FTP (6 each UDDS). After weighing each filter, following sampling, the filters were sealed in a bag and stored in a freezer at minus 18 degrees centigrade (0°F). All processing on the filters was conducted under yellow light. The analyses of these filters were not included as a part of this project and are not discussed in this report.

J. Computational Methods

The methods used for calculating the unregulated emissions results are given in Appendix A-3. All regulated emissions were calculated using the methods prescribed in the Code of Federal Regulations for Light-Duty Vehicles.(4) On the computer printouts for the regulated emissions, included in Appendices B and E, all items of potential interest are identified by descriptive headings. Items on the computer sheet identified only by abbreviated headings are used in calculating the unregulated emissions.

III. ANALYTICAL PROCEDURES FOR UNREGULATED EMISSIONS

The analytical procedures used to measure the unregulated emissions are summarized in this section. A detailed description of the procedures, along with a discussion of their development, validation, and qualification, is available in Interim Report II, "Analytical Procedures for Characterizing Unregulated Pollutant Emissions From Motor Vehicles," developed in a related EPA project.(3)

A. Description of the Analytical Procedures

The unregulated emissions evaluated in this project, along with the methods for sampling and the procedures used in the analyses, are listed in Table 7. Organic amines, aldehydes and ketones, organic sulfides, individual hydrocarbons, and metals and other elements represent groups of compounds. The respective procedures separate and identify a number of individual compounds within each of these groups. The analytical procedures involved in this project are briefly described as follows:

Organic Amines - The collection of organic amines (monomethylamine, monoethylamine and dimethylamines, trimethylamines, diethylamine, and triethylamines) is accomplished by bubbling CVS diluted exhaust through glass impingers containing dilute sulfuric acid. The amines are complexed by the acid to form stable sulfate salts which remain in solution. A portion of this solution is then injected into a gas chromatograph equipped with an ascarite loaded pre-column and a nitrogen phosphorus detector (NPD). External amine standards in dilute sulfuric acid are used to quantify the results. Some analyses were also conducted using undiluted exhaust.

Ammonia - Ammonia in CVS diluted automotive exhaust is measured in the protonated form, NH_4^+, after collection in dilute H_2SO_4. The acidification is carried out in a glass impinger maintained at ice bath temperature. A sample from the impinger is then analyzed for ammonia in an Ion Chromatograph and the concentration in the exhaust is calculated by comparison to an ammonium sulfate standard solution.

Aldehydes and Ketones - The collection of aldehydes (formaldehyde, acetaldehyde, isobutyraldehyde and hexanaldehyde) and ketones (acetone and methylethylketone) is accomplished by bubbling CVS diluted exhaust through glass impingers containing 2,4-dinitrophenylhydrazine (DNPH) in dilute hydrochloric acid. The aldehydes and ketones (also known as carbonyl compounds) react with the DNPH to form their respective phenylhydrazone derivatives. These derivatives are insoluble or only slightly soluble in the DNPH/HCl solution and are removed by filtration followed by pentane extractions. The filtered precipitate and the pentane extracts are combined and then the pentane is evaporated in a vacuum oven. The

TABLE 7. SAMPLING AND ANALYSIS METHODOLOGY FOR UNREGULATED EMISSIONS

Compound	Sampling	Method of Analysis
Organic Amines	Impinger	Gas chromatograph with ascarite pre-column and nitrogen-phosphorus detector (GC-NPD).
Ammonia (NH_3)	Impinger	Ion chromatograph
Aldehydes and Ketones	Impinger	Dinitrophenylhydrazone derivative. Gas chromatograph with flame ionization detector.
Hydrogen Sulfide (H_2S)	Impinger	Methylene blue derivative. Spectrophotometer.
Total Cyanide [Hydrogen Cyanide (HCN) and Cyanogen (C_2N_2)]	Impinger	Cyanogen chloride derivative. Gas chromatograph with electron capture detector (GC-ECD).
Carbonyl Sulfide (COS) and Organic Sulfides	Trap	Gas chromatograph with flame photometric detector (GC-FPD).
Nitrous Oxide (N_2O)	Bag	Gas chromatograph with electron capture detector (GC-ECD).
Nickel Carbonyl ($Ni(CO)_4$)	Bag	Chemiluminescence (CL).
Individual Hydrocarbons	Bag	Gas chromatograph with flame ionization detector.
Metals and Other Elements	Filter	Weighed using microbalance. Spectral X-ray analysis at RTP.
Particulates	Filter	Weighed using microbalance.
Sulfate	Filter	Barium chloranilate derivative (BCA). Liquid chromatograph with ultraviolet detector.
DMNA	Trap	Gas chromatograph with mass spectrometer at RTI (GC-MS).

remaining dried extract contains the phenylhydrazone derivatives. The extract is dissolved in a quantitative volume of toluene containing a known amount of anthracene as an internal standard. A portion of this dissolved extract is injected into a gas chromatograph and analyzed using a flame ionization detector.

Hydrogen Sulfide - The collection of hydrogen sulfide is accomplished by bubbling CVS diluted exhaust through glass impingers containing a buffered zinc acetate solution which traps the sulfide ion as zinc sulfide. The absorbing solution is then treated with N,N-dimethyl-paraphenylene diamine sulfate and ferric ammonium sulfate. Cyclization occurs, forming the highly colored heterocyclic compound methylene blue (3,9-bisdimethylaminophenazothionium sulfate). The resulting solution is analyzed with a spectrophotometer at 667 nm in a 1-cm or 4-cm pathlength cell depending upon the concentration.

Total Cyanide (Hydrogen Cyanide plus Cyanogen) - The collection of total cyanide is accomplished by bubbling CVS diluted exhaust through glass impingers containing a 1.0 N potassium hydroxide absorbing solution. This solution is maintained at ice bath temperature. An aliquot of the absorbing reagent is then treated with KH_2PO_4 and Chloramine-T. A portion of the resulting cyanogen chloride is injected into a gas chromatograph equipped with an electron capture detector (ECD). External CN^- standards are used to quantify the results.

Carbonyl and Organic Sulfides - The collection of carbonyl sulfide (COS) and the organic sulfides, methyl sulfide (dimethylsulfide, $(CH_3)_2S$), ethyl sulfide (diethylsulfide, $(C_2H_5)_2S$) and methyl disulfide (dimethyldisulfide, $(CH_3)_2S_2$), is accomplished by passing CVS diluted exhaust through Tenax GC traps at -76°C. At this temperature the traps remove the organic sulfides from the dilute exhaust. The organic sulfides are thermally desorbed from the traps into a gas chromatograph sampling system and injected into a gas chromatograph equipped with a flame photometric detector for analysis. External organic sulfide standards generated from permeation tubes are used to quantify the results.

Nitrous Oxide - For measurement of nitrous oxide, a sample of the CVS diluted exhaust is collected in a Tedlar bag. The bagged sample is then analyzed for nitrous oxide using a gas chromatograph equipped with an electron capture detector. Calibration blends are used to quantify the results. Gas chromatograph peak areas are obtained using a Hewlett-Packard 3354 computer system.

Nickel Carbonyl - Bagged samples of the CVS diluted exhaust are analyzed for nickel carbonyl ($Ni(CO)_4$) using a chemiluminescent NO_x analyzer modified with a No. 54 wratten filter. Bottled calibration blends are used to quantify the results. The instrument has linear response between 0.1 ppb and 0.1 ppm.

Individual Hydrocarbons - For measurement of selected individual hydrocarbons, methane (CH_4), ethane (C_2H_6), ethylene (C_2H_4), acetylene (C_2H_2), propane (C_3H_8), propylene (C_3H_6), benzene (C_6H_6), and toluene (C_7H_8), a sample of CVS diluted exhaust is collected in a Tedlar bag. This bagged sample is then analyzed for individual hydrocarbons using a gas chromatographic system containing four separate columns and a flame ionization detector. The peak areas are compared to an external calibration blend and the individual hydrocarbon concentrations are obtained using a Hewlett-Packard 3354 computer system.

Metals and Other Elements - The metals are collected as particulate on a 47-mm Fluoropore filter, which is then sent to Research Triangle Park (RTP) for analysis by X-ray spectroscopy. The diluted exhaust sample is taken isokinetically from wihtin the dilution tunnel. Weight gain on the filter is determined by weighing the filter on a microbalance before and after sampling.

Particulate - The "particulate" is collected isokinetically on a 47-mm glass fiber filter. The amount of "particulate" collected is determined by weighing the filter on a microbalance before and after sampling.

Sulfate - Automotive exhaust is vented into a dilution tunnel where it is mixed with a flowing stream of filtered room air. In the tunnel, the SO_3 reacts rapidly with water in the exhaust to form sulfuric acid aerosols. The aerosols grow to a filterable size range within the tunnel and are collected isokinetically on a fluorocarbon membrane filter. Particulate sulfate salts are also collected on the filter.

Sulfuric acid collected on the filter is then converted to ammonium sulfate by exposure to ammonia vapor. The soluble sulfates are leached from the filter with a measured volume of an isopropyl alcohol - water solution (60% IPA). A fixed volume of the sample extract is injected into a high pressure liquid chromatograph (HPLC) and pumped through a column of strong cation exchange resin in Ag^+ form to scrub out the halides (Cl^-, Br^-) and then through a column of strong cation exhange resin in H^+ form to scrub out the cations and convert the sulfate to sulfuric acid. Passage through a reactor column of barium chloranilate crystals precipitates out barium sulfate and releases the highly UV absorbing chloranilate ions. The amount of chloranilate ions released is equivalent to the sulfate in the sample and is measured by a sensitive liquid chromatograph UV detector at 310-313 nanometers. All the reactions and measurement take place in a flowing steam of 60% IPA. The scrubber and reactor columns also function as efficient filter media for any solid reaction products formed during passage of the sample through the column system.

DMNA - The attempted measurement of N-nitrosodimethylamine was accomplished by collecting dilute exhaust (approximately 185:1 total dilution) in Tenax GC sampling cartridges and shipping the cartridges to Research Triangle Institute (RTI) for analysis by capillary gas-liquid chromatography/mass spectrometry. The single ion monitoring (m/e 74) procedure used is not specific to DMNA. Results using this procedure represent a total composite value for all materials having background ions of m/e 74 and the same retention time as DMNA. A second cartridge was provided to enable a full scan analyses for any condition producing a relatively large indication of

DMNA. Since this procedure was not included in Interim Report II(3), a brief description of this procedure is included in Appendix A-3 of this report.

B. Validation and Qualification of the Analytical Procedures

The analytical procedures used in this project were previously subjected to a series of validation and qualification experiments. Validation experiments included checks for sample stability, sample collection efficiency, detector linearity, interferences, and analysis repeatability. The qualification experiments included the injection of the compound of interest into the tunnel with and without the presence of exhaust and the subsequent recovery of that compound at the procedure sampling point.

Sample stability checks were performed using repeated analyses of the same sample at intervals over a specified period of time and comparing the results to the initial analysis. Organic amines, aldehydes and ketones, ammonia, total cyanide, nitrous oxide and individual hydrocarbon samples were found to be stable for several days. Carbonyl and organic sulfides and the hydrogen sulfide samples were found to be stable for approximately one day. Nickel carbonyl is stable for only a few hours.

Sample collection efficiency experiments were performed by passing a known concentration of sample through a series of impingers or traps and analyzing each impinger or trap individually for the compound of interest. All procedures used in this project have a collection efficiency of 98% or better. Detector linearity experiments were performed by preparing several samples of various known concentrations and plotting the resulting peak areas versus the concentrations. All the procedures had linear response over the range of interest in this project.

To determine the interferences for each procedure, known exhaust components were introduced into the sample to determine their effect on the resultant measurements. To determine analysis repeatability, several samples of known concentrations were prepared and a number of complete analyses were performed at each concentration. The results of these tests were then compared to determine analyses repeatability.

The qualification experiments were performed to determine if the compounds of interest could travel the length of the dilution tunnel in the presence of dilute exhaust without significant loss by reaction with exhaust or the tunnel itself. The compounds were introduced at the same point at which the exhaust enters the tunnel and were sampled at the normal sampling point. Table 8 lists the procedures for which validation and qualification experiments were performed.

C. Accuracy of the Analytical Procedures

A difficult, but very important, endeavor was the determination of procedural accuracy for each analytical method. The primary difficulty involved those procedures in which the exhaust compounds are trapped or absorbed, an extraction or subsequent reaction is performed, and then a portion of the extraction is analyzed. After much consideration, in the previous malfunction project, the decision was reached to initially define

TABLE 8. PROCEDURAL VALIDATION AND QUALIFICATION

Compound or Compound Group	Validation Conducted	Qualification Conducted
Organic Amines	Yes	Yes (significant tunnel losses)
Ammonia	Yes	Yes (significant tunnel losses)
Aldehydes and Ketones	Yes	Yes
Hydrogen Sulfide	Yes	Yes
Total Cyanide	Yes	Yes
Carbonyl Sulfide and Organic Sulfides	Yes	Yes (significant tunnel losses)
Nitrous Oxide	Yes	Yes
Nickel Carbonyl	Yes	No[a]
Individual Hydrocarbons	Yes	No[b]
Metals and Other Elements	No[b]	No[b]
Particulates	No[b]	No[b]
Sulfate	No[b]	No[b]
DMNA	No[c]	No[c]

[a] Compound considered too dangerous to perform qualification experiments.

[b] Established procedure.

[c] Performed at RTP and RTI.

the accuracy in terms of a "minimum detection value" (MDV). The MDV, as used in this report, is defined as the value above which it can be said that the compound has been detected in the exhaust (i.e., the accuracy is equal to plus or minus the MDV at a measured value equal to the MDV). Determination of accuracy over the entire range of each procedure was beyond the scope of these projects.

For compounds collected by bag samples, the MDV was determined from the instrument detection limits only and is independent of the sampling rate and duration. For compounds which are concentrated in impingers or traps, the MDV is dependent on the instrument detection limit, chemical workup, sampling rate and sampling duration. The MDV's listed in Table 9 were derived using the listed sampling rates and a 23-minute sampling period.

TABLE 9. EMISSION PROCEDURAL SAMPLE RATES AND ACCURACY

	Mol. Wt.	Sample Flow ℓ/min	$\mu g/m^3$ per ppm	Procedural Minimum Detection Values[a]		MDV for FTP, mg/km[b]
				ppm	μg/m	
Test Number, PVM-ST	--	--	--	--	--	--
Barometer, mm Hg	--	--	--	--	--	--
Humidity, g/kg	--	--	--	--	--	--
Temperature, °C	--	--	--	--	--	--
Total Fuel Sulfur, mg/km	--	--	--	--	--	--
Avg. Exh. Oxygen	32.00	--	--	--	--	--
Catalyst Avg. Temp., °C	--	--	--	--	--	--
Catalyst Max. Temp., °C	--	--	--	--	--	--
Carbon Dioxide, g/km	44.01	Bag	--	--	--	--
Fuel Cons., ℓ/100 km	--	--	--	--	--	--
Regulated Emissions						
Hydrocarbons (THC)	11.88	Bag	575	1.0[c]	575	10
Carbon Monoxide	28.01	Bag	1165	2.0[c]	2330	40
Oxides of Nitrogen	46.01	Bag	1915	0.5[c]	958	16
Particulates						
Total Particulates	--	14.0	--	--	<50	<1
Sulfate	96.01	14.0	4000	<0.01	6	0.1
Compound Group Totals						
Aldehydes & Ketones	--	4.0	--	--	--	≃0.5
Individual Hydrocarbons	--	Bag	--	--	--	≃0.5
Organic Sulfides	--	0.13	--	--	--	≃0.05
Organic Amines	--	4.0	--	--	--	≃0.1
Other Compounds						
Ammonia	17.03	4.0	710	0.01	7	0.1
Cyanide & Cyanogen	26.02	4.0	1080	0.01	11	0.2
DMNA	74.08	5.0	3080	--	--	--
Hydrogen Sulfide	34.08	4.0	1415	0.01	14	0.2
Nickel Carbonyl	107.75	Bag	7100	0.0001	0.7	0.01
Nitrous Oxide	44.02	Bag	1830	0.01	18	0.3

[a] Based on a 23-minute sampling period at the specified flow rate for all impinger, filter and trap collected samples.

[b] Based on $\mu g/m^3$ in the diluted exhaust and typical UDDS (FTP 505 & 866) parameters (1371 seconds, 10 D.F., 206 m^3 CVS flow, 12.07 km, 0.98 DSFC) mg/km for FTP $\simeq \mu g/m^3 \times 206 \div 12.07 \times 0.98 \times 0.001 \simeq 0.0168 \times \mu g/m^3$. For SET: mg/km $\simeq$ 0.55 × mg/km for FTP. For HFET: mg/km $\simeq$ 0.74 × mg/km for FTP.

[c] Based on the instrument ranges generally used in this project.

TABLE 9 (CONT'D). EMISSION PROCEDURAL SAMPLE RATES AND ACCURACY

	Mol. Wt.	CRC[d] Synonym	$\mu g/m^3$ per ppm	Procedural Minimum Detection Values[a]		MDV for FTP, mg/km[b]
				ppm	$\mu g/m^3$	
Aldehydes and Ketones						
Formaldehyde	30.03	--	1250	0.01	15	0.2
Acetaldehyde	44.05	--	1830	0.01	20	0.3
Acetone[e]	58.08	2-Propanone	2415	0.01	25	0.4
Isobutyraldehyde		--	3000	0.01	30	0.5
Methyl Ethyl Ketone	72.12	2-Butanone	3000	0.01	30	0.5
Crotonaldehyde	70.09	2-Butenal	2915		--	--
Hexanaldehyde	100.16	Hexanal	4165	0.01	40	0.7
Benzaldehyde	106.13	--	4415	--	--	--
Individual Hydrocarbons						
Methane	16.04	--	665	0.05	30	0.5
Ethylene	28.05	Ethene	1165	0.03	30	0.5
Ethane	30.07	--	1250	0.03	30	0.5
Acetylene	26.04	Ethyne	1085	0.03	30	0.5
Propane	44.11	--	1835	0.02	30	0.5
Propylene	42.08	Propene	1750	0.02	30	0.5
Benzene	78.12	--	3245	0.02	30	0.5
Toluene	92.15	--	3830	0.02	30	0.5
Organic Sulfides						
Carbonyl Sulfide	60.08	--	2500	0.001	3	0.04
Methyl Sulfide	62.13	Dimethyl	2585	0.001	3	0.04
Ethyl Sulfide	90.19	Dimethyl	3750	0.001	4	0.06
Methyl Disulfide	94.20	Dimethyl	3915	0.001	4	0.06
Organic Amines						
Monomethylamine	31.06	Amino-Methane	1290	0.002	3	0.05
Monoethylamine[f]	45.09	Amino-Ethane	1875	0.002	4	0.05
Trimethylamine	59.11	--	2460	0.002	5	0.08
Diethylamine	73.14	--	3040	0.002	6	0.10
Triethylamine	101.19	--	4205	0.002	8	0.14

[a] & [b] See initial page of this table.

[d] Handbook of Chemistry and Physics, 54th Edition.

[e] Includes Acrolein - 56.07 and Propionaldehyde - 58.08 (CRC - Propenal and Propanal respectively).

[f] Includes Dimethylamine - 45.09.

IV. MALFUNCTION SELECTION AND SCREENING EVALUATIONS

Prior to starting the vehicle testing phase, on the automobile acquired for this project, a short series of tests were conducted. The purpose of these tests was to provide data toward selection of the four malfunction conditions. This section discusses the initial selection of malfunction conditions along with the results of the actual laboratory malfunction screening evaluations.

A. Selection of Malfunction Conditions

The 1979 Ford/Mercury Shop Manual was reviewed to determine operation of the Electronic Engine Control System (E.E.C. II) and provide input toward selection of potential malfunction conditions. The E.E.C. II consists of a Monitoring System, an Electronic Control Assembly and the Emission Control System. The control system can alter EGR flow, ignition timing, thermactor air flow and carburetor air/fuel ratio. A functional diagram of the E.E.C. II, adapted from the Shop Manual, is shown in Figure 4.

The Monitoring System consists of six sensor assemblies that monitor the following conditions:

Sensor	Condition Monitored
ECT	Engine Coolant Temperature
TP	Throttle Position
CP	Crankshaft Position
EGP	Oxygen Level in the Exhaust Gases
BMAP	Barometric Pressure and Manifold Absolute Pressure
EVP	EGR Valve Pintle Position

The Electronic Control Assembly (ECA) is a microcomputer which consists of a processor assembly and a calibration assembly. The processor assembly samples and processes the seven sensor input signals and sends control signals to the EGR, ignition and thermactor air systems and the feedback carburetor. The calibration assembly contains the "memory" and the programmed calibration information for the processor assembly.

The Emission Control System consists of a throttle kicker, exhaust gas recirculation (EGR), thermactor air, canister purge and ignition systems, and the feedback carburetor actuator (FBCA). The thermactor system is comprised of an air supply pump, an air bypass/diverter valve, air control solenoids, an exhaust check valve and dual catalytic converters. The following cutaway view of the dual catalytic converter and the description is taken directly from the Shop Manual.

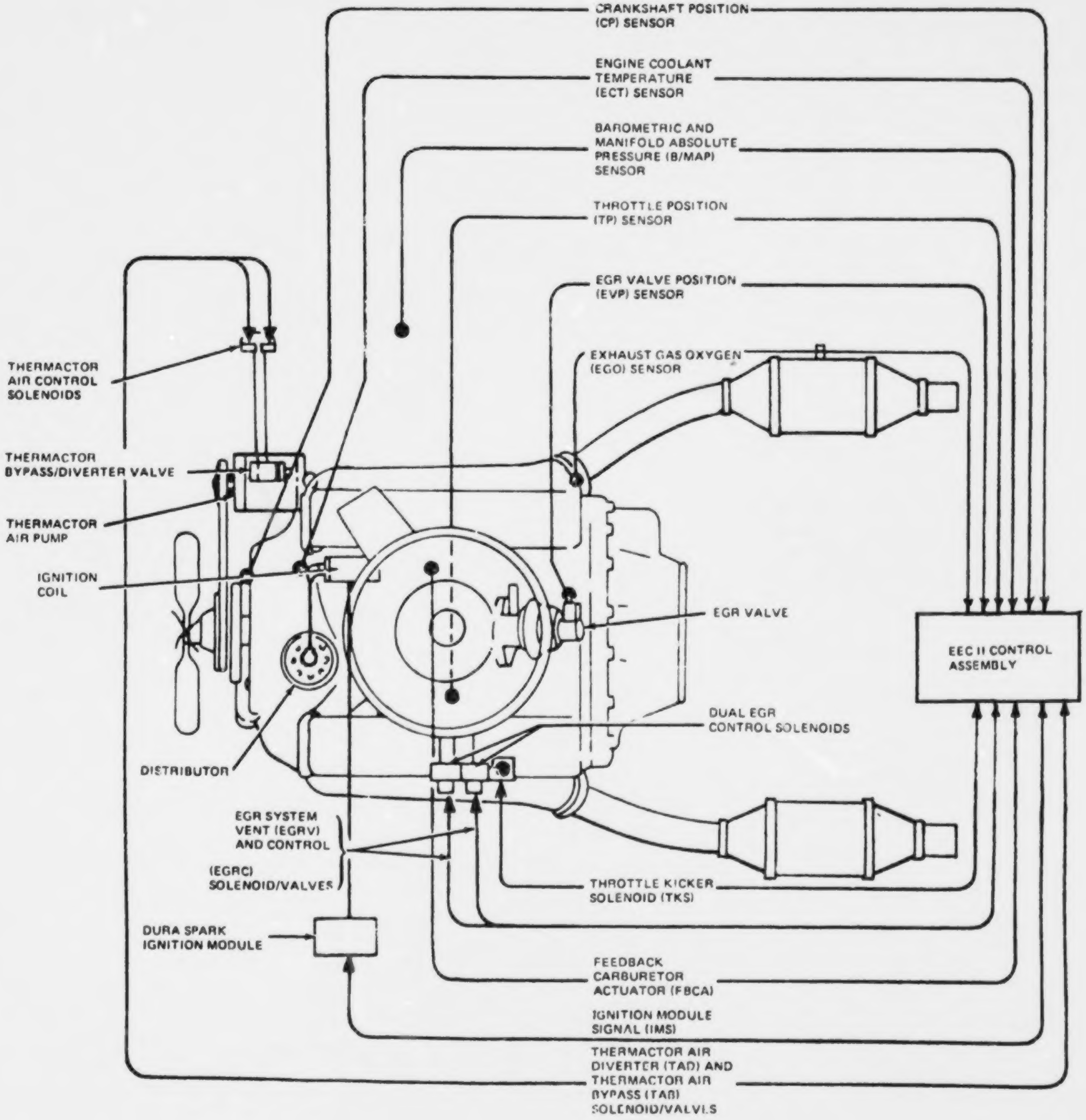
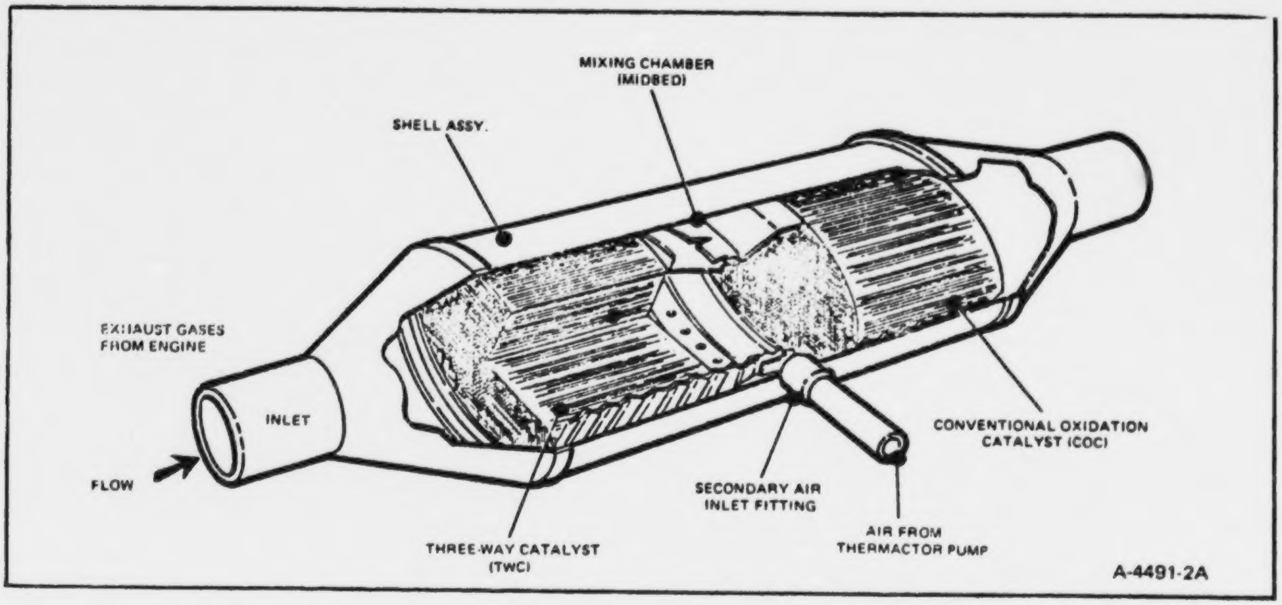

CRANKSHAFT POSITION (CP) SENSOR
ENGINE COOLANT TEMPERATURE (ECT) SENSOR
BAROMETRIC AND MANIFOLD ABSOLUTE PRESSURE (B/MAP) SENSOR
THROTTLE POSITION (TP) SENSOR
EGR VALVE POSITION (EVP) SENSOR
EXHAUST GAS OXYGEN (EGO) SENSOR
THERMACTOR AIR CONTROL SOLENOIDS
THERMACTOR BYPASS/DIVERTER VALVE
THERMACTOR AIR PUMP
IGNITION COIL
EGR VALVE
EEC II CONTROL ASSEMBLY
DUAL EGR CONTROL SOLENOIDS
DISTRIBUTOR
EGR SYSTEM VENT (EGRV) AND CONTROL
(EGRC) SOLENOID/VALVES
THROTTLE KICKER SOLENOID (TKS)
DURA SPARK IGNITION MODULE
FEEDBACK CARBURETOR ACTUATOR (FBCA)
IGNITION MODULE SIGNAL (IMS)
THERMACTOR AIR DIVERTER (TAD) AND THERMACTOR AIR BYPASS (TAB) SOLENOID/VALVES

Figure 4. Functional Diagram of the E.E.C. II


MIXING CHAMBER
(MIDBED)
SHELL ASSY.
EXHAUST GASES
FROM ENGINE
INLET
FLOW
CONVENTIONAL OXIDATION
CATALYST (COC)
SECONDARY AIR
INLET FITTING
AIR FROM
THERMACTOR PUMP
THREE-WAY CATALYST
(TWC)
A-4491-2A

> "The cutaway view shows the two separate catalytic converters, each composed of a ceramic "honeycomb" coated with catalytic meterial. The front converter is coated with a rhodium/platinum catalyst designed to control oxides of nitrogen (NO_x), unburned hydrocarbons (HC) and carbon monoxide (CO), and this is therefore called a "three-way catalyst" (TWC). The rear converter is coated with platinum catalyst and is called a "conventional oxidation catalyst" (COC) converter. The platinum catalyst is also sometimes called a "two-way catalyst" because it only acts on two of major pollutants, HC and CO."

The unmodified configuration and a number of the single component malfunctions, applicable to this system, are described as follows:

Unmodified Configuration - Engine tuned-up to manufacturer's specifications.

Disconnect Engine Coolant Temperature Sensor (Disabled Engine CTS) - The ECA would not be provided with an indication of when the coolant temperature reaches a preset temperature and would continue to call for a fuel-rich mixture.

Disable the Throttle Position Sensor (Disabled TPS) - The ECA would not be provided with an indication of the throttle position (e.g., whether the engine is operating at a closed, part or wide-open throttle).

Disconnect the Exhaust Oxygen Sensor (Disabled O_2 Sensor) - Fuel control system would operate in a preset mode without feedback control.

Disable the Barometric and Absolute Manifold Pressure Sensor (Disabled BMAP) - The signal from this sensor is used to determine part-throttle spark advance, EGR flow rate and air/fuel ratio.

Disable the EGR Valve Position Sensor (Disabled EGR Sensor) - The ECA would not be provided with an indication of the EGR valve position and the EGR valve would remain inoperable.

Disable the EGR Valve (Disabled EGR Valve) - No EGR would be provided to the engine.

Continuous Bypass of Thermactor Air (Air to Bypass) - The air supply would be bypassed into the atmosphere rather than into the exhaust system. This condition normally occurs when the control vacuum to the diverter valve drops below a preset value.

Continuous Upstream of Thermactor Air (Air to Manifold) - Additional air would always be injected into the exhaust manifold.

Continuous Downstream of Thermactor Air (Air to Catalyst) - Additional air would always be injected into the dual catalytic converter between the three-way and the oxidation catalysts.

Feedback Carburetor Actuator Disabled in Engine Start Position (Disabled FCA in Start) - The actuator would remain in a calibration dependent initial position.

Limited Operational Strategy Mode (LOS Mode) - Engine would operate with some of the output commands cutoff.

Engine Ignition Misfire (12 percent misfire) - Effectively random misfire of 12 percent of the ignition pulses.

In addition to these malfunctions, there are various potential multi-component malfunction configurations.

There were considerably more potential malfunctions than the up to seven malfunctions to be involved in the screening evaluations. Some of these potential malfunctions, however, could result in unacceptable driveability or have only a minor effect on emissions. Therefore, the approach followed was to initially make a cursory determination of regulated emissions and driveability in one hot-start, four-cycle FTP evaluation for each condition. (Cold start was also evaluated at several of the conditions where cold-start difficulties were anticipated).

Results of these preliminary malfunction screening evaluations are grouped and summarized in Table 10. The first group of malfunction conditions in Table 11 produced emissions not very significantly different from that produced in the unmodified configuration. The second group produced significantly higher NO_x and the third group produced significantly higher HC and/or CO. These results were utilized in the selection of the seven configurations to undergo more extensive malfunction screening evaluations.

TABLE 10. PRELIMINARY MALFUNCTION SCREENING RESULTS

	Four-Cycle FTP Emissions, g/km					
	Cold-Start			Hot-Start		
Configuration	HC	CO	NO_x	HC	CO	NO_x
Unmodified	0.1	1	0.8	0.1	1	0.5
Disabled TPS	---	--	---	<0.1	<1	0.6
Air to Catalyst	0.2	2	0.6	0.1	<1	0.5
Air to Manifold	---	--	---	<0.1	<1	0.8
Disabled BMAP	---	--	---	0.1	2	0.8
12 Percent Misfire	0.4	1	0.5	0.1	<1	0.3
LOS Mode	---	--	---	<0.1	<1	1.6
Disabled EGR Valve	---	--	---	0.1	<1	1.6
Disabled EGR Sensor	---	--	---	0.1	<1	2.0
Disabled O_2 Sensor	0.1	1	2.7	<0.1	<1	2.8
Air to Bypass	0.4	7	0.6	0.2	4	0.5
Disabled Engine CTS	---	--	---	0.5	15	3.2
Disabled FCA in Start	1.9	57	0.3	1.6	46	0.2

CTS - Coolant Temperature Sensor
TPS - Throttle Position Sensor
BMAP - Barometric and Absolute Manifold Pressure Sensor
FCA - Feedback Carburetor Actuator
LOS - Limited Operational Strategy Mode

B. Description of Malfunction Conditions

The unmodified configuration and the malfunction configurations selected to undergo more extensive screening evaluations are briefly described as follows:

Unmodified (Unmod.) - Car in standard configuration tuned-up to manufacturer's specifications.

Disabled Oxygen Sensor (w/o O_2) - The method used was to disconnect the electrical lead to the sensor. With the oxygen sensor disconnected, the fuel control system goes into a preset mode of operation.

Disabled Cold Temperature Sensor (w/o CTS) - Disconnection of the electrical wiring to the CTS. Fuel scheduling continues as though the engine coolant temperature remained below a preset level.

Disabled EGR Sensor (w/o EGR) - Disconnection of the electrical wiring to the EGR position sensor. With this malfunction, the EGR system does not function.

Engine Misfire - An Electronic Ignition Misfire unit was assembled in accordance with schematics obtained from the EPA Project Officer. The system was designed and used by Exxon Research and Engineering Company in a previous EPA contract. With only a few difficulties, the initial unit assembled by SwRI functioned well, reflecting good circuit design by Exxon.

Using a standard oscilloscope and the scope on a Sun 1120 Electronic Ignition Tester, it was determined that this unit functions as follows:

Misfire Setting, percent	Misfire Unit Operation
00.00 to 10.00	Misfires the tenth ignition signals to the extent necessary
10.00	Misfires every tenth ignition signal
10.01 to 19.99	Misfires every tenth ignition signal plus fifth ignition signals to the extent necessary
19.99	Misfires every tenth and essentially every fifth ignition signals (19.99 is the maximum setting)

Accuracy of this unit was determined by actual counts in slow-speed operation on a bench set-up and in higher speed operation on a vehicle using sequence comparison. The system was determined to be accurate to better than two decimal places (e.g., a setting of 10.01 percent produced 10.01 percent misfire). A second unit was loaned to another organization through the EPA. That organization, using a high-speed oscillograph, also reported that this misfire system was inherently accurate.

In the related malfunction projects, a misfire setting of twelve percent was used.(1,2) This amount of misfire was determined to be the limit at which driveability remained reasonably acceptable to some people. It was decided to also use a twelve percent ignition misfire setting in this project. This setting is considered to be representative of the extreme, rather than the most frequent misfire malfunction that might be encountered among the automobile population.

Disabled Air Pump - Disconnection of the air supply hose and plugging of the air system to the catalytic converter. This condition provides the same effect as obtained with air to Bypass.

Disabled Fuel Control Actuator (w/o FCA) - Disconnection of the electrical wiring to the FCA with the FCA in a cold-start setting.

C. Malfunction Screening Evaluations

A series of emissions evaluations was conducted to assist in the final selection of four malfunction configurations for use in the vehicle testing phase of this project. The results of these screening evaluations are summarized in Table 11. A more detailed summary, the repeat test data, the computer printouts for regulated emissions and the individual sample FTP results

TABLE 11. MALFUNCTION SCREENING FTP RESULTS
1979 Mercury Marquis with 351 "W" Engine

	Emissions in mg/km (Except as Noted)							
						DISABLED AIR PUMP		
	Unmod.	w/o O_2 Sensor	w/o CTS	w/o EGR Sensor	12% Misfire	w/o O_2	w/o CTS	w/o FCA
Test Number, PVM-ST	51A[a]	51B[a]	51C-2	51F-1	51M-1	51BH-1	51CH-2	51KH[a]
Barometer, mm Hg	744.3	743.7	741.7	753.1	738.9	749.0	739.9	742.0
Humidity, g/kg	7.2	8.5	10.6	4.4	7.5	4.6	6.5	7.0
Temperature, °C	24.5	24.8	26.7	25.6	24.4	23.9	23.9	25.9
Total Fuel Sulfur, mg/km	33.73	31.51	38.20	36.22	37.24	33.85	35.88	38.05
Avg. Exh. Oxygen, %	4.67	4.78	0.31	4.34	4.08	0.77	0.74	--
Catalyst Avg. Temp., °C	468	--	443	502	560	481	445	--
Catalyst Max. Temp., °C	540	--	553	639	769	584	588	541
Carbon Dioxide, g/km	367.2	345.4	329.2	394.0	404.6	355.6	321.5	298.6
Fuel Cons., ℓ/100 km	15.74	14.79	17.83	16.90	17.38	15.79	16.74	17.75
Regulated Emissions								
Hydrocarbons, (THC), g/km	0.12	0.09	1.53	0.14	0.50	0.52	1.54	2.29
Carbon Monoxide, g/km	0.74	0.49	53.21	0.98	0.62	8.14	41.87	70.06
Oxides of Nitrogen, g/km	0.79	2.93	1.89	2.90	0.75	2.05	1.90	0.41
Particulates								
Total Particulates	11.93	7.55	12.98	9.67	17.55	5.34	16.97	10.25
Sulfate	0.21	1.02	0.53	7.66	3.23	0.38	0.43	0.07
Sulfate as % of TFS, %	0.21	1.08	0.46	7.05	2.89	0.37	0.40	0.06
Compound Group Totals								
Aldehydes & Ketones	0.4	9.4	10.3	9.1	0.0	7.1	7.8	1.7
Individual Hydrocarbons	71.8	55.8	372.8	81.6	82.2	168.4	349.9	999.6
Organic Sulfides	0.02	0.23	0.00	0.56	0.23	0.77	0.00	0.51
Organic Amines	0.01	0.02	0.03	0.00	0.00	0.00	0.03	0.01
Other Compounds								
Ammonia	5.04	5.36	132.65	6.89	0.61	16.37	140.91	203.41
Cyanide & Cyanogen	0.08	--	49.29	0.00	0.04	6.69	26.07	35.45
Hydrogen Sulfide	0.03	0.00	0.45	0.00	0.11	0.14	0.35	1.06
Nickel Carbonyl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nitrous Oxide	23.89	16.32	73.17	103.63	--	43.93	60.43	17.09

[a] Average values for two tests

are given in Appendix B. The individual sample 4-bag results, given in Appendix B, are an approximation of the net emissions (exhaust minus background emissions).

The engine configurations, as used in these evaluations, are identified as follows:

Unmodified - Car in the standard configuration with the engine tuned-up to manufacturer's specifications.

Without O_2 Sensor - Electrical wiring to the oxygen sensor disconnected.

Without CTS - Electrical wiring to the cold temperature sensor disconnected.

Without EGR Sensor - Electrical wiring to the EGR sensor disconnected.

12% Misfire - Ignition misfiring at 12 percent.

Without FCA - Fuel control actuator disabled in the cold-start position.

Disabled Air Pump - No additional air provided to the catalytic converter. (This condition is equivalent to Air to Bypass).

Most of the repeat runs are reported in Appendix B-2. Included in that appendix table is Test 51CH-1 which involved an unscheduled malfunction that could not be defined. Questionable results also occurred in a couple of other tests, which were aborted. Test 51CH-1 was retained and processed due to the extremity of its regulated emission results. The results generally obtained in these evaluations, however, were in line with expected values. In subsequent checks and repeat runs, no additional difficulties were experienced Referring to the data in Appendix B-2 (and discounting Test 51CH-1), relatively good repeatability was obtained for essentially all emissions. A few, however, such as carbon monoxide, ammonia and sulfides did not always appear to repeat well. In most of these cases, however, the values being compared are relatively small. The extremely rich condition, that occurred during Test 51CH-1, primarily affected fuel consumption, the regulated emissions, particulates and measured individual hydrocarbons.

The conditions reported in Table 11, which produced relatively large increases in emissions, are resummarized in Table 12. The following discussion is based on Table 12 for compound groups and on Table 11 for single emission components and fuel consumption.

With the oxygen sensor disconnected, the major effect was an over three-fold increase in oxides of nitrogen. With the oxygen sensor and the air pump disabled, all three regulated emissions increased by two and one-half to ten times the unmodified value. Of possible interest is that fuel consumption did not appear to increase with the oxygen sensor disconnected.

Disconnecting the Cold Temperature Sensor (CTS), both with and without disabling the air pump, produced large increases in hydrocarbons, carbon

TABLE 12. CONFIGURATIONS WHICH PRODUCED RELATIVELY LARGE INCREASES IN EMISSIONS

Configuration	Emission Increased	Emission g/km	Emission Malf./Unmod.
Oxygen Sensor Disconnected	NO_x	2.9	4
	Aldehydes	0.009	25
Cold Temperature Sensor Disconnected (w & w/o Air)	HC	1.5	10
	CO	>40.	>50
	NO_x	1.9	2
	Aldehydes	> 0.008	20
	IHC	0.4	5
	Ammonia	> 0.13	25
	CN^-	> 0.03	N.A.
	N_2O	> 0.06	3
EGR Sensor Disconnected	NO_x	2.9	4
	Sulfate	0.008	35
	Aldehydes	0.009	25
	N_2O	0.10	4
12 Percent Misfire	Sulfate	0.003	15
Disabled O_2 Sensor & Air System	CO	8.1	10
	NO_x	2.1	3
	Aldehydes	0.007	20
	Ammonia	0.02	3
	CN^-	0.01	N.A.
	N_2O	0.04	2
Fuel Control Actuator Disabled in the Cold-Start Position	HC	2.2	20
	CO	70.0	90
	IHC	1.0	15
	Ammonia	0.20	40
	CN^-	0.04	N.A.
	H_2S	0.001	N.A.

NOTE: N.A. designates those values for which it was not applicable to calculate a ratio.

monoxide and fuel consumption, along with some of the higher values for oxides of nitrogen, aldehydes, ammonia, cyanides and nitrous oxide.

Disabling the Fuel Control Actuator (FCA) in the start position produced large increases in a number of emissions. It should be noted, however, that this malfunction probably has a relatively low change for occurrence. It was included in these screening evaluations since it represents an extreme condition. In general, it appears that overall, the unregulated emissions were not significantly greater in this configuration

With the EGR sensor disconnected, the oxides of nitrogen, sulfate and nitrous oxide increase by relatively large amounts.

With 12% ignition misfire, only particulates and sulfate increased by a relatively large amount. The catalyst maximum temperature also increased by a relatively large amount.

The individual malfunctions that were initially considered, can be divided into several separate categories. These categories are as follows:

Malfunction	Effect
w/o O_2 sensor & LOS mode	Operation outside of 3-way operating window
w/o CTS & w/o FCA	Very rich operation
w/o EGR (2 ways)	Major loss of NO_x control
12% Misfire	Fuel burned in catalyst after light-off rather than in the engine
w/o Air	Some loss of HC and CO control

The probability of the FCA failing in the start position appeared to be very low. The LOS Mode appeared to offer nothing that could not be obtained more assuredly by other means. The two methods of disabling the EGR system (sensor or vacuum source) appeared to produce essentially the same effect.

The four malfunction configurations selected for use in the vehicle testing phase of this project were as follows:

- Disconnected Oxygen Sensor
- 12% Misfire and Air to Bypass
- Disconnected EGR Sensor and Air to Bypass
- Disconnected Cold Temperature Sensor

These selected malfunction configurations were discussed with the Ford emissions representative and approved by the EPA Project Officer.

V. VEHICLE TESTING

Regulated and unregulated emissions from the 1979 Mercury Marquis were measured with the car operating under the four selected malfunction conditions. This car utilized a three-way catalyst, followed by an oxidation catalyst, with additional air added prior to the oxidation catalyst. This section presents the results of those evaluations.

A. Malfunctions Evaluated

The car, malfunction conditions, and procedures are described in previous sections II through IV. The malfunction conditions evaluated were as follows:

Test Series	Description
511	Disconnected Oxygen Sensor
512	12% Misfire and Air to Bypass
513	Disconnected EGR Sensor and Air to Bypass
514	Disconnected Cold Temperature Sensor

B. Regulated and Unregulated Emissions Test Results

Summaries of the test results are included in Appendix C. Individual sample data for the FTP evaluations are included in Appendix D and the computer printouts for the regulated emissions are included in Appendix E. The analyses and discussion of these test results are included in Section VI of this report.

In all data tables, a double dash (--) has been used when no test data were available. This occurs for those unregulated emissions which were only tested on a spot-check basis and when valid test data could not be obtained due to instrument malfunction or loss of the sample.

All FTP unregulated emissions data, with the exception of DMNA, are based on appropriately weighted four-cycle FTP results. The DMNA evaluations consisted of a single trap taken continuously over the first three cycles of the four-cycle FTP. If most of the DMNA were formed during the cold-start 505, then the reported DMNA data would be on the high side (up to a maximum of about 1.5 times the value that would be obtained in a standard weighted three-sample FTP). If the DMNA were produced at a constant rate in all three cycles, then such weighted composite results would be essentially identical to these continuous sample three-cycle results.

C. Short-Test Procedure Results

The regulated emissions were measured over two short driving cycles and two steady-state test procedures. Initially, in the related project(1), a Barnes "garage type" NDIR analyzer, obtained on loan from the EPA, was used to measure HC and CO in the undiluted exhaust. This analyzer developed serious operational difficulties and was replaced with laboratory grade NDIR instruments. The analyzers used are in a Beckman cart which was initially designed for and used in nine-mode heavy-duty engine evaluations. As specified, nitric oxide (NO) was determined with the chemiluminescence instrument in the NO mode (i.e., NO_2 to NO converter was bypassed).

The results of the short test evaluations are reported in Appendix F. Due to the apparent inconsistencies with some of the results, the steady-state tests for all configurations were repeated. These repeat runs, given in Appendix F-2, indicate that the initial results were not actually inconsistent.

The results of the initial short test evaluations are summarized in Table 13. These results indicate that there were no consistent quantitative relationships between the various cyclic and steady-state test results. For example, in Tests 512, 513 and 514, hydrocarbons varied from 1.59 to 1.83 in the FTP compared with 0.40 to 4.14 in the NYCC and 0.04 to 1.55 in the FSC. Oxides of nitrogen emissions for the FTP were four times as high in Test 511 than in Test 512, but were lower for the NYCC in Test 511 than in Test 512.

In reviewing the continuous dilute emission traces for the FTP, SET and HFET, it was determined that extremely high emission rates frequently occurred during rapid throttle change, while low emission rates occurred during essentially all other operation. This factor may have been associated with some of the apparent anomalies. In general, however, the reasons for the apparent anomalies were not readily apparent.

TABLE 13. SHORT-TEST PROCEDURES RESULTS

		Transient Cycle Tests				Steady State Raw Emissions Tests				
						TSIT		FTM		
UNMODIFIED		FTP	NYCC	FSC		2500	IDLE	52 MPH	25 MPH	IDLE
Hydrocarbons,	g/km	0.12	0.15	0.05	ppmH*	58	59	67	67	67
Carbon Monoxide,	g/km	1.35	1.55	1.02	%	<0.01	<0.01	<0.01	<0.01	<0.01
Oxides of Nitrogen,	g/km	0.85	1.00	0.48	ppmNO	240	35	925	263	35
511-2 Disabled O_2 Sensor										
Hydrocarbons,	g/km	0.09	0.07	0.03	ppmH*	67	261	71	49	261
Carbon Monoxide,	g/km	0.82	0.13	0.04	%	<0.01	0.3	<0.01	<0.01	0.3
Oxides of Nitrogen,	g/km	2.42	1.79	2.51	ppmNO	388	12	2288	830	17
512-2 12 Pct. Misfire w/o Air										
Hydrocarbons,	g/km	1.82	0.55	0.04	ppmH*	69	115	81	75	74
Carbon Monoxide,	g/km	8.86	5.16	0.15	%	<0.01	0.09	<0.01	<0.01	0.03
Oxides of Nitrogen,	g/km	0.61	1.98	1.18	ppm	150	1	850	100	2
513-2 Disabled EGR & Air										
Hydrocarbons,	g/km	1.59	0.40	0.12	ppmH*	178	406	157	237	492
Carbon Monoxide,	g/km	38.84	8.62	1.90	%	2.5	3.9	1.9	3.6	4.3
Oxides of Nitrogen,	g/km	0.46	1.66	1.92	ppm	120	7	470	86	6
514-2 Disconnected CTS										
Hydrocarbons,	g/km	1.83	4.14	1.55	ppmH*	162	241	130	183	256
Carbon Monoxide,	g/km	54.67	124.11	44.27	%	2.7	2.9	1.9	4.0	3.2
Oxides of Nitrogen,	g/km	0.34	0.43	0.27	ppm	52	3	250	22	3

* ppmH - Hydrocarbons as ppm Hexane measured using an Infrared Emission Analyzer
FTP - Light Duty Federal Test Procedure
NYCC - New York City Cycle
FSC - Federal Short Cycle
TSIT - Two Speed Idle Test
FTM - Federal Three Mode

VI. ANALYSES OF THE RESULTS

This section reports the analyses performed on the emissions data generated in this project. These analyses involved averaging and reformatting to enable making various comparisons of the data. Due to the very limited number of data points for each emission at each specific condition, advanced statistical analyses were judged to be inapplicable. Another limitation to further analyses was that criteria were not available to enable establishing acceptable or unacceptable concentrations of each emission in the exhaust. This precluded establishing the significance of the changes in emission levels that occurred. For example, a hundredfold increase in one emission does not necessarily represent a greater hazard than a tenfold, or possibly even lesser, increase in another emission.

Therefore, this section presents the data in formats that enable ready review and comparison. It is generally left up to the individual readers to apply their own interpretation as to the significance of the changes in the emission levels under the various operating conditions.

A. Average Values for the Unmodified Configuration

The initial analyses of the data involved averaging of the four evaluations conducted with each car in the unmodified configuration. These averages, along with the maximum and minimum values are presented in Appendix G,and are summarized in Table 14.

For the FTP, the HC and CO emissions were below all currently scheduled light-duty emission standards through 1985. The NO_x was below the 1980 Federal and the 1979 California emission standards. All unregulated emissions measured were relatively low in the FTP evaluations.

For the SET and HFET, relative to the FTP, emissions were generally either negligible or lower. The exceptions were NO_x, total particulates and sulfate. The NO_x remained essentially constant, while particulates and sulfate were an order of magnitude greater for the HFET than for the FTP.

Fuel Consumption results, for the unmodified configuration, are summarized as follows:

	Fuel Consumption Range		
	FTP	SET	HFET
Litre/100 km	15.4-16.1	11.4-12.0	10.2-10.6
Miles per gallon	14.6-15.3	19.6-20.6	22.2-23.1
(Max-Min)/Avg	4%	6%	6%

TABLE 14. AVERAGE VALUES FOR UNMODIFIED CONFIGURATION

	Emissions in mg/km (Except as Noted)		
	FTP[a]	SET	HFET
Regulated Emissions[a]			
Hydrocarbons, g/km	0.13	0.03	0.01
Carbon Monoxide, g/km	1.63	0.35	0.05
Oxides of Nitrogen, g/km	0.83	0.77	0.83
Particulates			
Total Particulates	4.1	18.8	36.4
Sulfate	0.9	12.4	27.1
Compound Group Totals			
Aldehydes & Ketones	2.6	2.0	0.6
Individual Hydrocarbons	69.	24.	9.
Organic Sulfides	0.21	0.11	0.04
Organic Amines	0.00	0.01	0.01
Other Compounds			
Ammonia	5.1	--	--
Cyanide & Cyanogen	0.31	--	--
Hydrogen Sulfide	0.00	0.00	0.00
Nickel Carbonyl	0.00	0.00	0.00
Nitrous Oxide	24.	11.	6.

[a] The 1979 Federal Emission Standards were 0.93, 9.32, 1.24 for HC, CO, NO_x. The 1979 California Standards were 0.25, 5.59, 0.93.

This amount of variation is considered as being good repeatability for the type of evaluations conducted. Also, the values for the FTP are in agreement with the 15 mpg given in the 1979 EPA-DOE Gas Mileage Guide.

B. Average Values for the Malfunction Configurations

The average values for the malfunction configurations, along with the average values for the unmodified configuration, are given in Appendix H. Various results have been separated out and are discussed in the following sections.

C. Analyses of Emissions and Fuel Consumption

The analyses of the regulated emissions and fuel consumption results were straightforward and test-to-test repeatability was generally good. The results of these analyses are discussed separately for the regulated and the unregulated emissions.

Regulated Emissions - A summary of the regulated emissions and fuel consumption data is presented in Table 15. The following comparisons are based on the 1979 Federal light-duty emission standards. Hydrocarbon emissions exceeded 0.9 grams per kilometer for three out of the four malfunctions evaluated. Carbon monoxide emissions exceeded 9 g/km in two out of the four malfunctions. Oxides of nitrogen emissions exceeded 1.24 g/km only with the oxygen sensor disconnected. These comparisons of the regulated emissions values to the 1979 Federal Standards (0.93, 9.3, 1.24 g/km for HC, CO, NO_x) are summarized as follows:

	Ratio of Emission Rate to the 1979 Federal Standard[a]				
	Unmod.	Dis. O_2 Sensor	12% Mis. w/o Air	Dis. EGR w/o Air	Disc. CTS
Hydrocarbons	0	0	2	2	2
Carbon Monoxide	0	0	1	4	6
Oxides of Nitrogen	1	2	0	0	0

[a] Values have been rounded off to zero or the nearest whole number.

Unregulated Emissions - A summary of the unregulated emissions results is given in Table 16. The unregulated emissions having the most significant changes in emissions rates were total particulates, sulfate, ammonia, cyanide-cyanogen, and hydrogen sulfide. Total particulates and sulfate decreased by relatively large amounts with all malfunction configurations in the SET and HFET evaluations. In the FTP evaluations, ammonia and cyanide-cyanogen increased by relatively large amounts with the CTS disconnected and with the EGR disabled plus air to bypass. Hydrogen sulfide emissions were highest with the CTS disconnected.

TABLE 15. SUMMARY OF AVERAGE REGULATED EMISSIONS AND FUEL CONSUMPTION DATA

	Unmod.	Disabled O_2 Sensor	Misfire + Air to Bypass	Disabled EGR + Air to Bypass	Disconnected CTS
FTP Results					
Hydrocarbons, g/km	0.13	0.11	1.73	1.49	1.80
Carbon Monoxide, g/km	1.63	0.96	8.91	35.45	52.41
Oxides of Nitrogen, g/km	0.83	2.51	0.60	0.55	0.36
Fuel Cons., ℓ/100 km	15.8	15.5	16.4	17.1	18.5
SET Results					
Hydrocarbons, g/km	0.03	0.04	0.35	0.45	1.05
Carbon Monoxide, g/km	0.35	0.23	2.93	11.45	36.06
Oxides of Nitrogen, g/km	0.77	2.70	0.44	0.75	0.26
Fuel Cons., ℓ/100 km	11.8	11.6	11.8	12.5	13.0
HFET Results					
Hydrocarbons, g/km	0.01	0.01	0.10	0.08	0.85
Carbon Monoxide, g/km	0.05	0.05	1.00	0.76	32.41
Oxides of Nitrogen, g/km	0.83	1.28	0.42	0.97	0.21
Fuel Cons., ℓ/100 km	10.4	9.8	10.7	11.3	12.0

Note: Values given are the average of up to four tests for the unmodified and two tests for the malfunction conditions.

TABLE 16. SUMMARY OF THE AVERAGE UNREGULATED EMISSIONS DATA

	Emissions in mg/km				
	Unmod.	Disabled O_2 Sensor	12% Misfire + Air to Bypass	Disabled EGR + Air to Bypass	Disconnected CTS
FTP Results					
Total Particulate	2.	6.	10.	6.	11.
Sulfate	0.9	1.3	0.1	0.2	0.2
Aldehydes & Ketones	3.	<1.	2.	3.	3.*
Organic Sulfides	0.2	0.6	0.2	0.1	0.3*
Organic Amines	0.0	0.0	<0.1	<0.1	<0.1
Ammonia	5.	3.	31.	172.	253.
Cyanide & Cyanogen	0.3	0.1*	1.6	70.	112.
Hydrogen Sulfide	0.0	0.0	0.6	0.4	1.0
Nickel Carbonyl	0.00	0.00	0.00	0.00	0.00
Nitrous Oxide	24.	11.	12.	88.	43.
SET Results					
Total Particulate	18.	4.	4.	6.	5.
Sulfate	12.	2.1	<0.1	0.1	0.1
Aldehydes & Ketones	2.	<1.	<1.	<1.	<1.
Organic Sulfides	0.1	0.3	<0.1	<0.1	0.2
Organic Amines	<0.1	0.0	<0.1	<0.1	<0.1
Ammonia	--	--	--	--	--
Cyanide & Cyanogen	--	--	--	--	--
Hydrogen Sulfide	0.0	0.1	0.5	0.7	2.0
Nickel Carbonyl	0.00	0.00	0.00	0.00	0.00
Nitrous Oxide	11.	8.	5.	37.	17.
HFET Results					
Total Particulate	48.	10.	1.	2.	3.
Sulfate	27.	5.	<0.1	0.1	<0.1
Aldehydes & Ketones	1.	<1.	1.	1.	1.
Organic Sulfides	<0.1	0.8	<0.1	<0.1	0.2
Organic Amines	<0.1	0.0	<0.1	<0.1	<0.1
Ammonia	--	--	--	--	--
Cyanide & Cyanogen	--	--	--	--	--
Hydrogen Sulfide	0.0	0.0	0.1	0.4	3.2
Nickel Carbonyl	0.00	0.00	0.00	0.00	0.00
Nitrous Oxide	6.	4.	2.	8.	9.

*Validity of the average value is questionable.

D. General Effects of Malfunctions on Emissions

In this section an attempt has been made to give the reader a general idea of the effects of car and malfunction configuration on emissions. Due to the lack of established levels of significance for the unregulated emissions, it can not be established at this time whether or not any of the changes in emission levels are a definite cause for concern.

An evaluation that can provide some insight is whether the respective malfunctions caused increases in emissions relative to the unmodified configuration. The results of such an evaluation for the FTP results are summarized in Table 17.

E. Other Elements and DMNA

An illustrative summary of the results for the elemental analyses, in the FTP evaluations, is given in Table 18. With the exception of the three relatively high chlorine values (0.66, 0.33, 2.26), all values are within the range encountered in the previous project involving three-way catalyst cars.(1) The causes for these relatively high chlorine values are not known.

DMNA analyses were conducted only for the unmodified and the disabled oxygen sensor configurations. No DMNA was detected, by the measurement method used, in either of these two evaluations.

F. Maximum Emission Values

The highest of the averaged emission values were determined and these data are presented in Table 19. These data are listed separately for the unmodified and for the malfunction configurations. The last two pages of Table 19 identify the car test which produced the respective maximum value.

Table 19 is intended to provide some insight into which compounds may be of potential concern. After "threshold levels for concern" are established for the unregulated emissions, this table will enable ready screening to determine which of the unregulated emissions may be a potential cause for concern; and perhaps aid in setting priorities for further investigations into possible hazardous toxicity effects. Further review of the results given in Appendix H would then be required to establish whether or not concern is actually justified.

Another analysis considered was the percentage change in emission rates for each malfunction condition relative to the unmodified configuration. Two considerations tend to preclude the usefulness of such an analysis. One consideration was that the concentrations for some of the compounds were near the "minimum detection value." Percentage change for these compounds would be essentially meaningless. A second consideration was the previously mentioned lack of "threshold levels for concern."

G. Relative Importance of the Maximum Emission Rates

There are proposed or established automotive source emission standards

TABLE 17. RELATIONSHIP OF MALFUNCTION TO UNMODIFIED EMISSIONS RESULTS FOR THE FTP

		Relationship of Malfunction to Unmodified			
	Unmod., mg/km	Dis. O_2 Sensor	12% Mis. w/o Air	Dis. EGR w/o Air	Disabled CTS
Regulated Emissions					
Hydrocarbons, (THC), g/km	0.13	D	I	I	I
Carbon Monoxide, g/km	1.63	D	I	I	I
Oxides of Nitrogen, g/km	0.83	I	D	D	D
Particulates					
Total Particulates	2.0	I	I	I	I
Sulfate	0.9	I	D	D	D
Compound Group Totals					
Aldehydes & Ketones	2.6	D	D	I	S
Individual Hydrocarbons	69.	S	I	I	I
Organic Sulfides	0.2	I	D	D	I
Organic Amines	0.00	S	I	I	I
Other Compounds					
Ammonia	5.1	D	I	I	I
Cyanide & Cyanogen	0.3	D	I	I	I
Hydrogen Sulfide	0.00	S	I	I	I
Nickel Carbonyl	0.00	S	S	S	S
Nitrous Oxide	24.	D	D	I	I

I = Increase, D = Decrease, S = Same

TABLE 18. SUMMARY OF THE ELEMENTAL ANALYSES RESULTS FOR THE FTP

	Exhaust Emission, mg/km[b]						
	Pb	Al	S	Cl	Fe	Ba	Ca
Tasks 1 & 3[a]		0.04	0.49	0.66	0.96		0.03
51U	0.07		0.19	0.32	0.12		
511	0.12		0.03	0.03	0.10		
512	0.24		0.04	2.26	0.50		
513	0.10		0.53		0.53		0.03
514		0.04	0.06	0.05	0.25	0.03	

Pb - Lead
Al - Aluminum
S - Sulfur
Cl - Chlorine
Fe - Iron
Ba - Barium
Ca - Calcium

Test	General Description
51U	Unmodified
511	Disabled O_2 Sensor
512	12% Misfire + Air to Bypass
513	Disabled EGR + Air to Bypass
514	Disconnected CTS

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[a] Maximum values are reported for the Task 1 and 3 malfunction screening evaluations.

[b] Only values greater than 0.02 are included in this table.

TABLE 19. HIGHEST OF THE AVERAGED EMISSION RATES

	Emission Rate, mg/km (Except as Noted)					
	FTP		SET		HFET	
	Unmod.	Malf.	Unmod.	Malf.	Unmod.	Malf.
Regulated Emissions						
Hydrocarbons, g/km	0.13	1.80	0.03	1.05	0.01	0.85
Carbon Monoxide, g/km	1.63	52.41	0.35	36.06	0.05	32.41
Oxides of Nitrogen, g/km	0.83	2.51	0.77	2.70	0.83	1.28
Particulates						
Total Particulates	2.01	11.34	18.84	5.75	48.43	9.93
Sulfate	0.85	1.30	12.36	2.11	27.14	5.19
Compound Group Totals						
Aldehyde & Ketones	2.6	2.9	2.0	0.7	0.6	1.3
Individual Hydrocarbons	69.1	721.9	24.4	463.2	9.0	383.2
Organic Sulfides	0.21	0.61	0.11	0.28	0.04	0.81
Organic Amines	0.00	0.05	0.01	0.02	0.01	0.02
Other Compounds						
Ammonia	5.05	252.97	--	--	--	--
Cyanide & Cyanogen	0.31	112.29	--	--	--	--
Hydrogen Sulfide	0.00	0.96	0.00	2.00	0.00	3.18
Nickel Carbonyl	0.00	0.00	0.00	0.00	0.00	0.00
Nitrous Oxide	24.12	87.88	10.65	37.34	5.51	8.88
Aldehydes & Ketones						
Formaldehyde	2.41	1.27	1.76	0.63	1.14	0.38
Acetaldehyde	0.11	1.17	0.19	0.36	0.04	0.13
Acetone	0.01	1.10	0.03	0.23	0.00	0.16
Isobutyraldehyde	0.08	1.10	0.03	0.23	0.05	0.95
Methyl Ethyl Ketone	0.00	0.13	0.00	0.07	0.00	0.12
Hexanaldehyde	0.00	0.00	0.00	0.00	0.00	0.00
Individual Hydrocarbons						
Methane	45.56	139.75	21.00	84.19	8.27	72.13
Ethylene	4.69	185.57	0.58	111.62	0.00	93.53
Ethane	4.63	18.95	1.76	12.65	0.53	11.77
Acetylene	1.58	3.27	0.00	0.00	0.00	0.00
Propane	0.63	2.56	0.03	1.24	0.13	1.05
Propylene	1.90	76.02	0.00	52.18	0.00	47.34
Benzene	4.65	125.43	0.83	79.33	0.02	68.86
Toluene	5.45	191.12	0.19	122.02	0.01	88.55
Organic Sulfides						
Carbonyl Sulfide	0.13	0.17	0.03	0.15	0.03	0.26
Methyl Sulfide	0.04	0.14	0.03	0.14	0.01	0.26
Ethyl Sulfide	0.02	0.20	0.03	0.01	0.00	0.05
Methyl Disulfide	0.01	0.11	0.02	0.01	0.00	0.24

TABLE 19 (Cont'd). HIGHEST OF THE AVERAGED EMISSION RATES

	Emission Rate, mg/km (Except as Noted)					
	FTP		SET		HFET	
	Unmod.	Malf.	Unmod.	Malf.	Unmod.	Malf.
Organic Amines						
Monomethylamine	0.00	0.02	0.00	0.02	0.01	0.02
Monoethylamine	0.00	0.03	0.00	0.01	0.00	0.02
Trimethylamine	0.00	0.01	0.00	0.00	0.00	0.00
Diethylamine	0.00	0.00	0.00	0.00	0.00	0.00
Triethylamine	0.00	0.00	0.00	0.00	0.00	0.00
Other Elements						
Chromium						
Lead	0.07	0.24		0.09		0.25
Manganese						
Arsenic						
Mercury						
Bromine				0.02		
Phosphorus		0.01		0.01		0.01
Silicon		0.01	0.01	0.01	0.01	
Cadmium						
Aluminum	0.01	0.04		0.01		0.01
Sulfur	0.19	0.53	4.83	0.94	7.95	2.05
Sodium						
Fluorine						
Magnesium						
Potassium						
Chlorine	0.32	2.26	0.01	1.78	0.01	1.65
Platinum						
Zinc		0.02				
Copper		0.02				
Nickel						
Iron	0.12	0.53	0.04	0.22		0.20
Vanadium						
Titanium						
Barium	0.01	0.03	0.01	0.01	0.01	0.01
Cesium						
Calcium	0.01	0.03	0.01	0.01	0.01	0.01
Tin						
Antimony						
Palladium						

Note: Values for all spaces left blank for "Other Elements" are 0.00.

TABLE 19 (Cont'd). HIGHEST OF THE AVERAGED EMISSION RATES

	Car Test Number for Malfunction		
	FTP	SET	HFET
Regulated Emissions			
Hydrocarbons, g/km	514	514	514
Carbon Monoxide, g/km	514	514	514
Oxides of Nitrogen, g/km	511	511	511
Particulates			
Total Particulates	514	513	511
Sulfate	511	511	511
Compound Group Totals			
Aldehydes & Ketones	513	513	512
Individual Hydrocarbons	514	514	514
Organic Sulfides	511	511	511
Organic Amines	513	513	512, 514
Other Compounds			
Ammonia	514	--	--
Cyanide & Cyanogen	514	--	--
Hydrogen Sulfide	514	514	514
Nickel Carbonyl	--	--	--
Nitrous Oxide	513	513	514
Aldehydes & Ketones			
Formaldehyde	513	513	513
Acetaldehyde	514	514	512
Acetone	514	514	513
Isobutyraldehyde	513	512	514
Methyl Ethyl Ketone	511	511	511
Hexanaldehyde	--	--	--
Individual Hydrocarbons			
Methane	514	514	514
Ethylene	514	514	514
Ethane	514	514	514
Acetylene	514	--	--
Propane	514	514	514
Propylene	514	514	514
Benzene	512	514	514
Toluene	514	514	514
Organic Sulfides			
Carbonyl Sulfide	511	511	511
Methyl Sulfide	511	511	511
Ethyl Sulfide	511	514	511
Methyl Disulfide	511	514	511

TABLE 19 (Cont'd). HIGHEST OF THE AVERAGED EMISSION RATES

	Car Test Number for Malfunction[a]		
	FTP	SET	HFET
Organic Amines			
Monomethylamine	512, 513, 514	513	514
Monoethylamine	513	512	512
Trimethylamine	513	--	--
Diethylamine	--	--	--
Triethylamine	--	--	--
Other Elements			
Chromium			
Lead	512	512	512
Manganese			
Arsenic			
Mercury			
Bromine		512	
Phosphorus	512,514	514	513
Silicon	513	513,514	
Cadmium			
Aluminum	514	511, 513, 514	511, 513
Sulfur	513	513	513
Sodium			
Fluorine			
Magnesium			
Potassium			
Chlorine	512	512	512
Platinum			
Zinc	513		
Copper	512		
Nickel			
Iron	513	512	513
Vanadium			
Titanium			
Barium	514	511, 512, 514	511, 512, 513, 514
Cesium			
Calcium	513	511, 513, 514	513
Tin			
Antimony			
Palladium			

Note: Values for all spaces left blank for "Other Elements" are 0.0.

[a] 511 - Disconnected Oxygen Sensor
512 - 12% Misfire and Air to Bypass
513 - Disconnected EGR Sensor and Air to Bypass
514 - Disconnected Cold Temperature Sensor

for four of the compounds evaluated in this project. Such standards can be utilized in a comparative analyses of the emission results for those compounds. For most of the compounds evaluated, however, standards have not been established and attempted analyses of relative importance requires the application of some other available criteria.

The data from Table 19 were converted into units of mg/m^3 in the undiluted exhaust and these converted data are presented in Table 20. Table 20 also lists the Threshold Limit Values (TLV) for those substances included in the "Registry of Toxic Effects of Chemical Substances."(8) Some additional FTP relative values for the regulated emissions are given as follows for reference purposes:

	Mass Emission Rate		Equivalent Level in FTP Raw Exhaust [a]
	g/km	g/mi	mg/m^3
HC	0.9	1.5	550
HC	0.25	0.41	150
CO	9.3	15	5500
CO	4.4	7	2500
CO	2.1	3.4	1200
NO_x	1.2	2.0	700
NO_x	0.6	1.0	350
NO_x	0.25	0.41	150

[a] Approximate values based on the relationship for the one car evaluated in this project.

The conversion from an emission rate in g/km to mg/m^3 was determined by the total volume of the undiluted exhaust and the total distance driven for each test. The volume of undiluted exhaust differs for each malfunction condition, generally as a function of the fuel consumption rate. For generating Table 20, and the additional FTP relative values, a relationship was used which tends to correct all data to an equivalent undiluted exhaust flow rate equal to the lowest for any of the configurations evaluated. This was done in order to equalize the data to a common basis and eliminate the relative reduction obtained by configurations having high exhaust flow rates.

These data are summarized further and compared to the emissions standards and the TLV in Table 21. The values summarized in Table 21 are intended to provide some possible idea of the relative importance, based on toxicity, for some of the compounds evaluated. It should be emphasized, however, that definite conclusions are currently inappropriate for any compounds; except possibly those for which automotive source emission standards have been established. It should be recognized that the hazard level of a compound may change based on new findings in health effect research. This is especially a factor when a compound is changed from a toxic concern to a carcinogenic concern; such as is apparently occurring with benzene and formaldehyde. Also, some compounds which

TABLE 20. MAXIMUM EMISSION LEVELS IN THE UNDILUTED EXHAUST[a]

	Approximate Emission Level in Undiluted Exhaust, mg/m^3[b]						
	FTP		SET		HFET		TLV,(8)
	Unmod.	Malf.	Unmod.	Malf.	Unmod.	Malf.	mg/m^3
Regulated Emissions							
Hydrocarbons	80	1,100	20	800	10	800	--
Carbon Monoxide	1,000	31,400	300	27,000	50	29,000	55
Oxides of Nitrogen	500	1,500	600	2,000	700	1,200	9
Particulates							
Total Particulates	1.2	6.8	14.1	4.3	43.6	8.9	--
Sulfate	0.5	0.8	9.3	1.6	24.4	4.7	--
Compound Group Totals							
Aldehydes & Ketones	1.6	1.7	1.5	0.5	0.5	1.2	--
Individual Hydrocarbons	41.	433.	18.	347.	8.	345.	--
Organic Sulfides	0.1	0.4	0.1	0.2	<0.1	0.7	--
Organic Amines	0.0	<0.1	<0.1	<0.1	<0.1	<0.1	--
Other Compounds							
Ammonia	3.0	151.8	--	--	--	--	35
Cyanide & Cyanogen	0.2	67.4	--	--	--	--	5[c]
Hydrogen Sulfide	0.0	0.6	0.0	1.5	0.0	2.9	20[d]
Nickel Carbonyl	0.0	0.0	0.0	0.0	0.0	0.0	0.007
Nitrous Oxide	14.5	52.7	8.0	28.0	5.0	8.0	--
Aldehydes & Ketones							
Formaldehyde	1.5	0.8	1.3	0.5	1.0	0.3	4
Acetaldehyde	<0.1	0.7	0.1	0.3	<0.1	0.1	360
Acetone	<0.1	0.7	<0.1	0.2	0.0	0.1	2400
Isobutyraldehyde	<0.1	0.7	<0.1	<0.1	<0.1	0.9	--
Methyl Ethyl Ketone	0.0	<0.1	0.0	<0.1	0.0	0.1	590
Hexanaldehyde	0.0	0.0	0.0	0.0	0.0	0.0	--
Individual Hydrocarbons							
Methane	27.	84.	16.	63.	7.	65.	--
Ethylene	3.	111.	<1.	84.	0.	84.	--
Ethane	3.	11.	1.	9.	<1.	11.	--
Acetylene	1.	2.	0.	0.	0.	0.	2400
Propane	<1.	2.	<1.	1.	<1.	1.	1800
Propylene	1.	46.	0.	39.	0.	43.	--
Benzene	3.	75.	<1.	60.	<1.	62.	33
Toluene	3.	115.	<1.	92.	<1.	80.	760
Organic Sulfides							
Carbonyl Sulfide	0.08	0.10	0.02	0.11	0.03	0.23	--
Methyl Sulfide	0.02	0.08	0.02	0.11	0.01	0.23	--
Ethyl Sulfide	0.01	0.12	0.02	0.01	0.00	0.05	--
Methyl Disulfide	0.01	0.07	0.02	0.01	0.00	0.22	--

TABLE 20 (Cont'd.) MAXIMUM EMISSION LEVELS IN THE UNDILUTED EXHAUST[a]

	Approximate Emission Level in Undiluted Exhaust, mg/m^3 [b]						TLV,(8) mg/m^3
	FTP		SET		HFET		
	Unmod.	Malf.	Unmod.	Malf.	Unmod.	Malf.	
Organic Amines							
Monomethylamine	0.00	0.01	0.00	0.02	0.01	0.02	--
Monoethylamine	0.00	0.02	0.00	0.01	0.00	0.02	--
Trimethylamine	0.00	0.01	0.00	0.00	0.00	0.00	--
Diethylamine	0.00	0.00	0.00	0.00	0.00	0.00	75
Triethylamine	0.00	0.00	0.00	0.00	0.00	0.00	100
Other Elements							
Chromium							1
Lead	0.04	0.14		0.07		0.23	0.2
Manganese							5[c]
Arsenic							0.5
Mercury							--
Bromine				0.02			0.7
Phosphorus		0.01		0.01		0.01	--
Silicon			0.01	0.01	0.01		--
Cadmium							0.2
Aluminum	0.01	0.02		0.01		0.01	--
Sulfur	0.11	0.32	3.62	0.71	7.16	1.85	--
Sodium							--
Fluorine							0.2
Magnesium							--
Potassium							--
Chlorine	0.19	1.36	0.01	1.34	0.01	1.49	3
Platinum							[d]
Zinc		0.01					--
Copper		0.01					--
Nickel							1
Iron	0.07	0.32	0.03	0.17		0.18	--
Vanadium							--
Titanium							--
Barium	0.01	0.02	0.01	0.01	0.01	0.01	[e]
Cesium							--
Calcium	0.01	0.02	0.01	0.01	0.01	0.01	--
Tin							[f]
Antimony							0.5
Palladium							--

---

[a] Maximum of the average values.

[b] Derived on a wet basis using the following approximate calculation:
mg/m^3 Conversion Factor x mg/km. C.F.= Distance/Total Volume x Dilution Factor
FTP = 0.60 SET = 0.75 HFET = 0.90

[c] Ceiling value.

[d] 0.002 for soluble salts.

[e] 0.5 for soluble compounds

[f] 2 for inorganic compounds, 0.1 for organic compounds

TABLE 21. RELATIVE IMPORTANCE OF MAXIMUM EMISSION RATES

	Maximum Emission Rate (MER) in mg/km	Emission Standard for 1983 in mg/km	Equivalent MER in Undiluted Exhaust in mg/m3 (MEC)	Threshold Limit Value (TLV) in mg/m^3		Ratio of MEC to TLV
				OSHA(8)	R[c]	
Regulated Emissions						
Hydrocarbons	1,800[a]	255	1,100	--	--	--
Carbon Monoxide	52,400[a]	2,113	31,400	55	--	571
Oxides of Nitrogen	2,500[a]	622[b]	1,500	9	--	167
Particulates						
Total Particulates	11[a]	124[d]	7[e]	--	1	7[e]
Sulfate	27	--	24	--	1	24
Compound Group Totals						
Aldehydes & Ketones	3	--	2	--	--	--
Organic Sulfides	1	--	1	--	10	<1
Organic Amines	<1	--	<1	--	>10	<1
Other Compounds						
Ammonia	253	--	152	35	--	4
Cyanide & Cyanogen	112	--	67	--	5	13
Hydrogen Sulfide	3	--	3	--	10	<1
Nickel Carbonyl	0	--	0	0.007	--	0
Nitrous Oxide	88	--	53	--	--	--
Formaldehyde	2	--	2	4	--	<1
Benzene	125	--	75	33	--	2

---

[a] FTP rate recorded for the regulated emissions and total particulates

[b] 255 mg/km in California

[c] Based on values for some similar or Related compounds as set by OSHA(8) or Recommended by the 1968 American Conference of Governmental Industrial Hygienists (9)

[d] Proposed for Diesel cars

[e] Values were 44 for the HFET

are considered by OSHA and other agencies as being non-toxic can have a potential, indirect harmful effect (e.g., nitrous oxide is one example of such a compound due to its potential effect on the atmospheric ozone layer). The ambient air standards were also reviewed for possible inclusion in Table 21. Due to the varied ways in which the standards are expressed, however, there did not appear to be an appropriate method for including such standards in this comparative analyses.

With reference to Table 21, the maximum FTP composite emission rates for HC, CO,and NO_x greatly exceeded the standards for 1983 (0.41, 3.4, and 1 g/mi for HC, CO, and NO_x). The maximum value for total particulates, however, was less than one-tenth of the proposed 0.2 g/mi particulate standard for 1983 Diesel cars.

Also, in Table 21, the maximum emission concentrations (MEC) are compared with the Threshold Limit Values (TLV), as established by OSHA for exposure in any 8-hour work shift. For many of the compounds listed, it would appear that the higher the MEC to TLV ratio the more likely the maximum emission rate would be of concern from a toxicity viewpoint.

The maximum undiluted exhaust emission concentrations for carbon monoxide and oxides of nitrogen exceeded the TLV by over 100. Other compounds in the undiluted exhaust, which exceeded an established TLV, were ammonia and benzene; by factors of 4 and 2 respectively. As a matter of possible interest, the value for carbon dioxide was over 20 times the established TLV.

For the remaining compounds and compound groups, it was necessary to estimate an equivalent TLV based on best available data.(8,9) Based on these estimated values, the maximum levels for total particulates and sulfate were above the estimated values for an equivalent TLV by factors of 7 and 24, respectively. Total particulates for the HFET exceeded the equivalent TLV by a factor of 26 and this value occurred in the unmodified configuration.

In summary, these comparisons of the emissions results with the TLV's are only intended to provide some relative means of interpreting the data obtained in this project. These relative comparisons generally apply only to toxicity and the hazardous characteristic on an individual component basis. Other areas, such as carcinogenicity and cumulative, synergistic and indirect effects, must be considered before any definite conclusions can be made.

LIST OF REFERENCES

1. Urban, C. M., "Regulated and Unregulated Exhaust Emissions from Malfunctioning Three-Way Catalyst Gasoline Automobiles," Final Report to Environmental Protection Agency under Contract No. 68-03-2588, January 1980.

2. Urban, C. M., "Regulated and Unregulated Exhaust Emissions from Malfunctioning Non-Catalyst and Oxidation Catalyst Gasoline Automobiles," Final Report to Environmental Protection Agency under Contract No. 68-03-2499, January 1980.

3. Dietzmann, H. E., et al, "Analytical Procedures for Characterizing Unregulated, Pollutant Emissions from Motor Vehicles," Report EPA 600/2-79-017, February 1979.

4. Code of Federal Regulations, Title 40, Chapter 1, Part 85, Subpart H, Sections applicable to 1979 Model Year Light-Duty Vehicles.

5. Congested Freeway Driving Schedule (Appendix VIII in the Recommended Practice for Measurement of Exhaust Sulfuric Acid Emission from Light-Duty Vehicles and Trucks, November 1976.

6. Highway Fuel Economy Driving Schedule (Federal Register, Vol. 41, No. 100, May 21, 1976, Appendix I).

7. 55 mph Alternate Mileage Accumulation Procedure (MSAPC A/C No. 37, December 20, 1973, Enclosure 1).

8. U.S. HEW "Registry of Toxic Effects of Chemical Substances," 1976 and 1978 Editions.

9. Proceedings of the 1968 American Conference of Governmental Industrial Hygienists as reported in the Fifth Edition of the "Matheson Gas Data Book."

APPENDICES

A - GENERAL INFORMATION
B - MALFUNCTION SCREENING EVALUATIONS
C - SUMMARIES OF VEHICLE TESTING RESULTS
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APPENDIX A

GENERAL INFORMATION

A-1 Modified Durability Driving Schedule
A-2 Short-Test Procedures
A-3 Analytical Procedure for DMNA
A-4 Calculations for Unregulated Emissions

APPENDIX A-1. MODIFIED DURABILITY DRIVING SCHEDULE FOR MILEAGE ACCUMULATION ON PUBLIC ROADS

The following schedule is shown on Figure A-1:

1. Leave Institute Fleet Laboratory.
2. Proceed to CULEBRA ROAD via INSTITUTE ROAD, 20 & 30 m.p.h.
3. Stop at CULEBRA.
4. Left turn onto CULEBRA and proceed to "A", 410, at 40 m.p.h. (Distance from Fleet Laboratory to "A" is 2.3 miles).
5. Stop at "A", idle 15 sec.
6. Start lap prompter at 1.
7. Accelerate from stop, turn left on access road.
8. After left turn, accelerate to lap speed and then decelerate at "B" to 20 m.p.h., as traffic permits.
9. Accelerate to lap speed as you turn onto 410. Continue on 410 to next exit and then decelerate at "C" to 20 m.p.h., as traffic permits then accelerate to lap speed.
10. Continue on FRONTAGE ROAD until a full stop can be safely made at area of point "D". Idle for 15 secs.
11. Accelerate from stop to lap speed and pull onto 410 at next ramp. Continue on 410 to next exit ramp.
12. Take exit, then decelerate to 20 m.p.h., at "E".
13. Accelerate to lap speed.
14. Stop at "F" and idle 15 secs.
15. Accelerate to lap speed and continue to "G". Decelerate to 20 m.p.h. at "G" then accelerate to lap speed.
16. Stop at traffic light if red, "H" (this can be as long as 33 secs.). If the light is green, proceed and make an additional stop along the North lap as traffic permits.
17. As you pass "H" stop light. push the "lap" prompter and observe the "lap speed."
18. Left turn on MARBACH under 410. Stop at light "I". If light is green, proceed on North lap and make additional stop as traffic permits.
19. Left turn to 410 access at "I".

APPENDIX A-1 (Cont'd.). MODIFIED DURABILITY DRIVING SCHEDULE FOR MILEAGE ACCUMULATION ON PUBLIC ROADS

20. Proceed up 410 to "J" at lap speed.

21. Decelerate at "J" to 20 m.p.h. and then accelerate to lap speed.

22. Continue to "K" at lap speed.

23. Decelerate at "K" to 20 m.p.h. and then accelerate to lap speed.

24. Take ramp to 410 and proceed up 410 to exit ramp at "L".

25. Decelerate at "L" to 20 m.p.h. and then accelerate to lap speed.

26. Proceed to "M", then stop and idle 15 secs.

27. Accelerate to lap speed then decelerate at "N" to 20 m.p.h., and then accelerate to lap speed.

28. Take ramp to 410 and continue on 410 to CULEBRA exit ramp.

29. Take CULEBRA exit to stop at "A". Idle 15 secs.

30. Push "lap" prompter for next lap and lap speed.

31. This begins the 3rd lap.

32. Continue with South lap - North lap sequence until lap Number 9 is complete.

33. Lap Number 10 is run at a steady 55 m.p.h. on 410. Get on 410 at first entrance ramp following the stop at the end of lap Number 9 and stay on 410.

34. Lap 10 is completed when you stop at "A" or "H" after pulling off onto the ramp nearest the stop.

35. After stop at "A" or "H", Lap Number 10 is complete.

36. Punch lap button for Lap 11.

37. Accelerate then stop at "B".

38. Accelerate to lap speed then decelerate to stop at "D".

39. Accelerate to lap speed then decelerate to stop at "F".

40. Accelerate to lap speed then decelerate to stop at "H".

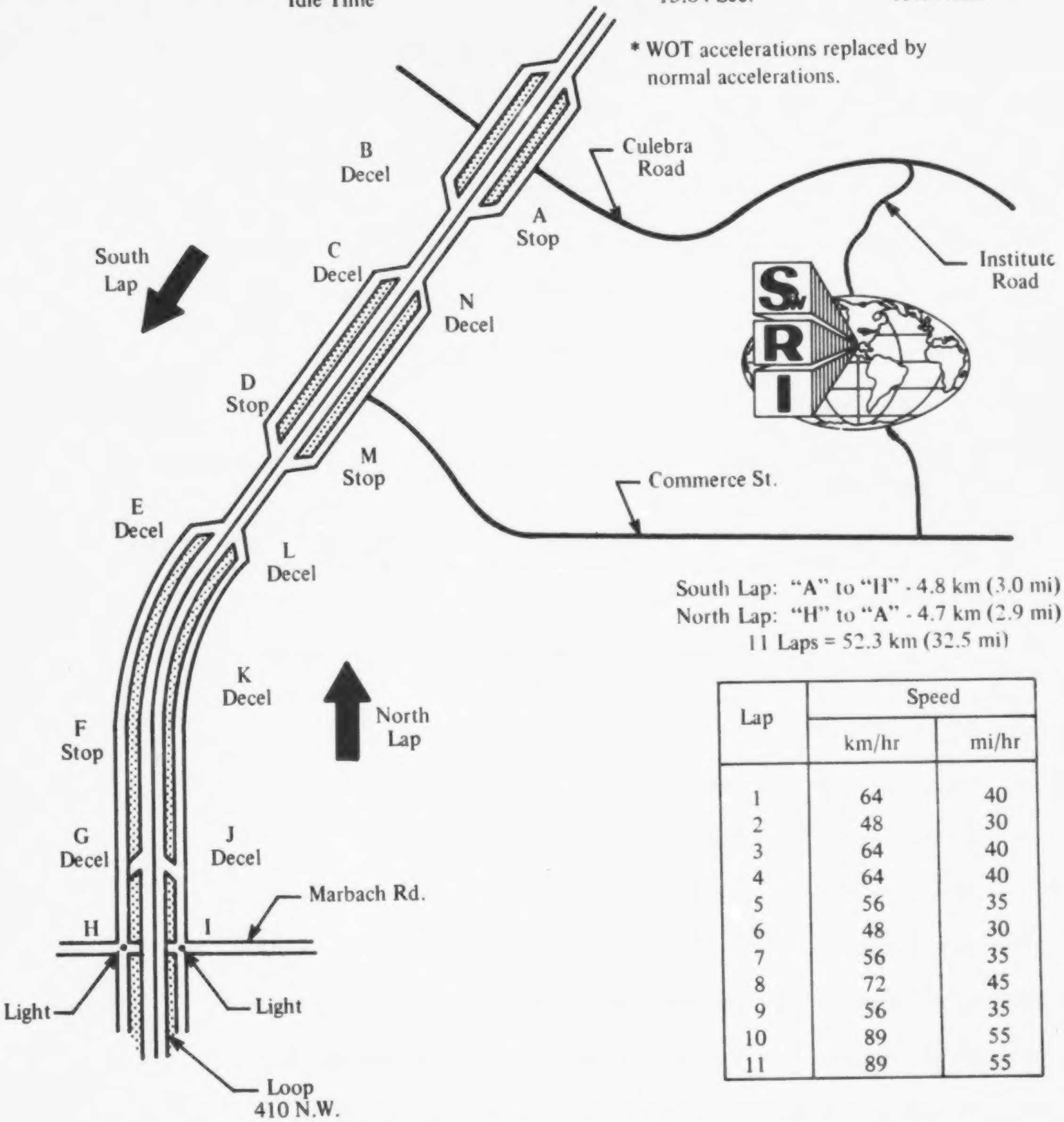
41. This completes one cycle of the mileage accumulation.

42. The next cycle of the schedule begins at "H".

43. Complete as many steps per shift as time will allow, then return to the Fleet Laboratory.

	Events Per Mile	
	55 mph Top Speed	
Driving Mode	SwRI Course*	AC No. 37
Stops	1.02	1.01
Normal Accelerations from Stop	1.01	0.91
Normal Accelerations from 20 mph	1.11	1.11
Wide-Open Throttle Accelerations and Fast Deceleration	0.00	0.10
Idle Time	13.84 Sec.	13.64 Sec.

* WOT accelerations replaced by normal accelerations.


B Decel
Culebra Road
A Stop
South Lap
C Decel
N Decel
Institute Road
SwRI
D Stop
M Stop
Commerce St.
E Decel
L Decel
K Decel
North Lap
F Stop
G Decel
J Decel
Marbach Rd.
H
I
Light
Light
Loop 410 N.W.

South Lap: "A" to "H" - 4.8 km (3.0 mi)
North Lap: "H" to "A" - 4.7 km (2.9 mi)
11 Laps = 52.3 km (32.5 mi)

Lap	Speed	
	km/hr	mi/hr
1	64	40
2	48	30
3	64	40
4	64	40
5	56	35
6	48	30
7	56	35
8	72	45
9	56	35
10	89	55
11	89	55

Figure A-1. Modified (automobile) durability driving schedule for mileage accumulation on public roads

APPENDIX A-2. SHORT-TEST SEQUENCE AND PROCEDURES

DILUTE EMISSIONS TESTING - CVS

1. Check Inertia and Horsepower (set same settings as for FTP)
2. Run 505 Seconds of the FTP
3. Idle 6 minutes and Neutral with Fan On
4. Run NYCC and take bag sample
5. Idle 6 minutes in Neutral with Fan On
6. Run FSC and take bag sample at flow rate of 1 cfm

RAW EMISSIONS TESTING - HC by NDIR and NO by CL for Undiluted Emissions

7. Idle 6 minutes in Neutral with Fan On
8. Run TWO SPEED IDLE TEST (TSIT) - 3 minutes total at each condition
    a. 2500 rpm in Neutral - measure during minutes 2 through 3
    b. Normal Idle in Neutral - measure during minutes 2 through 3
9. Continue Normal Idle for 6 minutes Total
10. Set Inertia at 1750
11. RUN FEDERAL THREE MODE (FTM)

Minute 1 - Set 18[a] Horsepower at 52 mph
2 - Stabilize
3 - Measure Emissions

Minute 4 - Set 9.5[a] Horsepower at 25 mph
5 - Stabilize
6 - Measure Emissions

Minute 7 - Idle in Neutral
8 - Stabilize
9 - Measure Emissions

---

[a] Horsepower from a table based on NADA weight and 400 lbs.

Federal Short Cycle (FSC)

Within two hours of the FTP, SET or HFET emissions evaluations, precondition the engine by driving the first 505 seconds of the FTP Driving Sequence. With the fan left on and the hood left open, immediately follow the 505 with six (6) minutes (± 1 minute) of operation at idle with the transmission in neutral. Immediately following the six minutes of idle, begin the Federal Short Cycle which is described as follows:

Mode	Time in mode (secs)
0-16 mph acceleration	6
16-29 mph acceleration	23
29 mph cruise	10
29-37 mph acceleration	18
37-42 mph acceleration	4.5
42-37 mph deceleration	2.5
37-20 mph deceleration	32
20- 0 mph deceleration	7.5
Idle	21.5
	125.0 seconds total

The dynamometer loadings and transmission shift points follow the procedure as required for the FTP. A minimum of 2 cu. ft. of sample exhaust is required in the sample bag.

Two-Speed Idle Test (TSIT)

This short test consists of volumetric sampling of undiluted exhaust emissions during two steady-state operating conditions with the hood open and the cooling fan on. The first operating mode is 2500 engine rpm with the transmission in neutral. The second mode is normal idle with the transmission in neutral.

Two Speed Idle Tests shall be preceded by a six minute idle period, as described under the Federal Short Cycle. At the end of the idle period, the vehicle will be operated for a maximum of three minutes at 2500 rpm and then at idle speed. At each speed, equilibrium of engine speed and the CO, HC and NO analyzer output meters shall be maintained for 30 seconds before the readings are recorded. CO, HC and NO shall be measured and reported in % CO, ppm Hexane and ppm NO, respectively.

Federal Three Mode Test (FTM)

This short test consists of three steady-state operating modes (similar to Clayton Key Mode) from which undiluted exhaust samples are taken with the dynamometer loads simulating the average power which occurs at the appropriate speed on the FTP with all light-duty vehicles being grouped into weight classes. The test will be conducted with the vehicle's hood open and auxiliary cooling fan in use. The inertia weight setting is 1750 pounds and the road load settings for the 25 and 52 mph speeds are determined from a chart.

The FTM test procedure is preceded by a six-minute idle period, as described under the Federal Short Cycle. At the end of the idle period, the vehicle will be operated for a maximum of three minutes at the Mode specified speed. During the first two minutes in each mode, the specified dynamometer load horsepower shall be set and the system shall reach stabilization. The test shall be performed in the order of high cruise, low cruise, and idle. At each speed, equilibrium of vehicle speed and the CO, HC and NO analyzer meters shall be maintained for 30 seconds before the readings are recorded. CO, HC and NO shall be measured by the volumetric procedure and reported in % CO, ppm Hexane, and ppm NO, respectively.

APPENDIX A-3. ANALYTICAL PROCEDURE FOR DMNA

The following description of the analytical procedure for DMNA was excerpted from a copy of the Special Interim Technical Report for EPA Contract No. 68-02-2767. The interim report was prepared by Dr. E. D. Pellizzari of the Research Triangle Institute for Dr. Ron Bradow of the Environmental Protection Agency, Research Triangle Park. The procedure described was used by the Research Triangle Institute in performing the DMNA analyses reported in this final report.

ANALYSIS FOR N-NITROSODIMETHYLAMINE IN EXHAUST GASES USING A TENAX GC CARTRIDGE AND GAS CHROMATOGRAPHY/MASS SPECTROMETRY/COMPUTER

EPA Contract No. 68-02-2767

TRI/1514/00-01S

N-NITROSODIMETHYLAMINE AND AMBIENT AIR
ANALYTICAL METHOD

Analyte:	DMN	Method No:	
Matrix:	Air	Range:	0.5 ppt - 10 ppb
Procedure:	Absorption on Tenax GC, thermal desorption with He purge, measurement by capillary gas-liquid chromatography/ mass spectrometry	Precision:	±10%
Date Issued:		Classification:	E(Proposed)
Date Revised:			

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1. Principle of the Method

N-nitrosodimethylamine (DMN) is concentrated from ambient air on Tenax GC in a short glass tube. It is desorbed by heating and purging with helium into a liquid nitrogen cooled nickel capillary trap and then introduced into a high resolution gas chromatographic column where it is separated from interferences. The concentration of DMN is measured from the mass spectrometric signal at m/e 74.

2. Range and Sensitivity

2.1 The range of the mass spectrometric signal for the conditions listed corresponds to 0.5 ppt to 10 ppb.

2.2 A concentration of 0.5 ppt of DMN can be determined in a 150-liter air sample.

3. Interferences

Interferences may result from materials having backgrouns ions of m/e 74 ($C_2H_8N_3$, $C_2H_4NO_2$, $C_2H_6N_2O$, C_3H_3Cl, C_3H_6S, $C_3H_6O_2$, or $C_3H_{10}N_2$) if at the same retention time of DMN.

4. Precision and Accuracy

4.1 The precision of this method has been determined to be ±10% of relative standard deviation when replicate sampling cartridges were spiked with 50 ng (corresponding to 10 ppb in 150 ℓ of air). These data were obtained using 10.0 cm long glass tubes (1.5 cm i.d.) packed with 35/60 mesh of Tenax GC (bed dimensions: 1.5 cm × 6 cm in depth).

4.2 The accuracy of the analysis is approximately ±10% of the amount reported as determined from repeated analysis of several standards.

5. Advantages and Disadvantages of the Method

5.1 The gas chromatography-mass spectrometry technique interfaced with a Finnigan glass jet separator (Model 01512-42158 Finnigan Corp., Sunnyvale, CA) is extremely sensitive and specific for the analysis of DMN. The high resolution gas chromatographic separation yields a retention time that is characteristic for DMN, and relatively specific for positive assignment of the signal as DMN. The mass spectrometer in combination with high resolution gas chromatography yields a very high degree of specificity. The base peak of DMN is at m/e 74 which is also the parent ion. In order to assign the signal at m/e 74 to DMN it is absolutely necessary that the retention time matches with the signal.

5.2 Collected samples can be stored up to 1 month with less than 10% lossess.

5.3 Because DMN is a suspected carcinogen in man it is extremely important to exercise safety precautions in the preparation and disposal of liquid and gas standards, cleaning of used glassware, etc., and the analysis of air samples.

5.4 Since the mass spectrometer can not be conveniently mobilized, sampling must be carried out away from the instrument.

5.5 High resolution gas chromatography/low resolution mass spectrometry is not a convenient technique for handling a large number of samples (>100/wk).

5.6 Efficiency of air sampling increases as the ambient air temperature decreases (i.e., sensitivity increases).

5.7 Ambient air sampling is limited to cases where the NO_x levels are less than 3 ppm when dimethylamine is also present.

APPENDIX A-4. CALCULATIONS FOR UNREGULATED EMISSIONS

This appendices documents the calculational methods used for the unregulated emissions. All values not defined (i.e., CVS FLOW, VOL, etc.) are obtained from the computer printouts for the regulated emissions. Example printout is included as Table 1.

A. Individual Hydrocarbons, Nickel Carbonyl, N_2O and H_2S

1. For FTP Evaluations only, convert 2-Bag UDDS to Equivalent 1-Bag UDDS

$$\text{PPM } 12 = \frac{\text{PPM}_1 \times \text{CVS FLOW}_1 + \text{PPM}_2 \times \text{CVS FLOW}_2}{\text{CVS FLOW}_1 + \text{CVS FLOW}_2}$$

$$\text{PPM } 34 = \frac{\text{PPM}_3 \times \text{CVS FLOW}_3 + \text{PPM}_4 \times \text{CVS FLOW}_4}{\text{CVS FLOW}_3 + \text{PPM FLOW}_4}$$

2. Convert PPM to $\mu g/m^3$:

$$\mu g/m^3 = 35.32 \times \text{DENSITY} \times \text{PPM}$$

Density, g/ft^3

Methane CH_4	- 18.86	Propane C_3H_8	- 17.29
Ethylene C_2H_4	- 16.50	Propylene C_3H_6	- 16.50
Ethane C_2H_6	- 17.68	Benzene C_6H_6	- 15.33
Acetylene C_2H_2	- 15.33	Toluene C_7H_8	- 15.49
H_2S	- 40.12	N_2O	- 51.82
NH_3	- 20.05	$Ni(CO)_4$	-200.99

B. Calculation of mg/km

$$\text{mg/km} = \Big((\text{EXH} \times \text{SCF} - \text{BG} \times \text{DFC}) \times \text{VOL} \div \text{KM}\Big) \div 1000$$

Calculations were performed using a Hewlett Packard HP-65 Programmable Calculator

Dry (DFC) and (SFC) was used for all unregulated emissions except: IHC, N_2O and $Ni\ (CO)_4$

DFC and SCF are obtained from the computer print-out for regulated emissions. (See Tables 1 and 2.)

C. Metals and Other Elements

COMPONENT WEIGHT ON FILTER = $\mu g/cm^2$ × EFF. FILTER AREA

EFF. FILTER AREA = 14.3 cm^2

COMPONENT $\mu g/m^3$ = C.W.O.F. ÷ TOTAL WT. × ($\mu g/m^3$ for Total Wt.)

APPENDIX A-4 (Cont'd). CALCULATIONS FOR UNREGULATED EMISSIONS

D. Calculation of Average Temperature and Oxygen

$$\text{Average} = \frac{\text{INTEGRATOR COUNTS}}{6.994 \times \text{SECONDS}} \times \text{FULL SCALE VALUE}$$

= % for Oxygen

= MV for Catalyst Temperature

E. Calculation for 4-FTP

$$\text{Composite 4-FTP} = 0.43 \times (\text{Value for 1\&2}) + 0.57 \times (\text{Value for 3\&4})$$

Appendix A-4 (Cont'd). CALCULATIONS FOR UNREGULATED EMISSIONS

TABLE 1. COMPUTER PRINTOUT NOMENCLATURE FOR FOUR-BAG FTP

```
                                             PVM -      FTP  VEHICLE EMISSIONS RESULTS - MALFUNCTION CONDITION
                                                             PROJECT

TEST NO.             RUN                                VEHICLE NO.                                        TEST WEIGHT       KG(        LBS)
VEHICLE MODEL                                           DATE                                               ACTUAL ROAD LOAD      KW(        HP)
ENGINE      L(     CID)                                 BAG CART NO.                                       GASOLINE  EM-
TRANSMISSION A3                                         DYNO NO.                                           ODOMETER         KM(        MILES)
GVW       KG(        LBS)                               CVS NO.

BAROMETER        MM HG(       IN HG)                    DRY BULB TEMP.      DEG C(      DEG F)
RELATIVE HUMIDITY    PCT                                ABS. HUMIDITY      GM/KG                           NOX HUMIDITY CORRECTION FACTOR
BAG RESULTS
   BAG NUMBER                                                   1                    2                    3                     4
   DESCRIPTION                                          COLD TRANSIENT          STABILIZED          HOT TRANSIENT          STABILIZED

   BLOWER DIF P MM. H2O(IN. H2O)
   BLOWER INLET P MM. H2O(IN. H2O)
   BLOWER INLET TEMP. DEG. C(DEG. F)
   BLOWER REVOLUTIONS
   CVS FLOW STD. CU. METRES(SCF)
   HC  SAMPLE METER/RANGE/PPM
   HC  BCKGRD METER/RANGE/PPM
   CO  SAMPLE METER/RANGE/PPM
   CO  BCKGRD METER/RANGE/PPM
   CO2 SAMPLE METER/RANGE/PCT
   CO2 BCKGRD METER/RANGE/PCT
   NOX SAMPLE METER/RANGE/PPM
   NOX BCKGRD METER/RANGE/PPM
   DILUTION FACTOR

   HC  CONCENTRATION PPM
   CO  CONCENTRATION PPM
   CO2 CONCENTRATION PCT
   NOX CONCENTRATION PPM
   HC  MASS GRAMS
   CO  MASS GRAMS
   CO2 MASS GRAMS
   NOX MASS GRAMS

   HC  GRAMS/KM
   CO  GRAMS/KM
   CO2 GRAMS/KM
   NOX GRAMS/KM
   FUEL CONSUMPTION BY CB L/100KM

   RUN TIME                SECONDS
   AVG. EXH. OXYGEN        PERCENT
   CATALYST AVG. TEMP.     DEG. C
   CATALYST MAX. TEMP.     DEG. C
   MEASURED DISTANCE       KM
        DFC, WET (DRY)
        SCF, WET (DRY)
        VOL (SCM)
        KM  (MEASURED)

COMPOSITE RESULTS                                                                                                        3-BAG        (4-BAG)
   TEST NUMBER                        TOTAL FUEL SULFUR   MG/KM              CARBON DIOXIDE       G/KM                    (       )
   BAROMETER     MM HG                AVG. EXH. OXYGEN    PCT                FUEL CONSUMPTION     L/100KM                 (       )
   HUMIDITY      G/KG                 CATALYST AVG. TEMP. DEG C              HYDROCARBONS (THC)   G/KM                    (       )
   TEMPERATURE   DEG C                CATALYST MAX. TEMP. DEG C              CARBON MONOXIDE      G/KM                    (       )
                                                                             OXIDES OF NITROGEN   G/KM                    (       )
```

APPENDIX A-4 (Cont'd). CALCULATION FOR UNREGULATED EMISSIONS
TABLE 2. DEFINITION OF COMPUTER PRINTOUT NOMENCLATURE

FOR FOUR-BAG AND SINGLE-BAG

REGULATED EMISSIONS

The following are primarily exerpts taken from the computer program:

AVG. EXH. OXYGEN: Direct printout of an input

CATALYST AVG. AND MAX. TEMPS.: Input converted to °C and printed-out

```
C    DFC = DILUTION FACTOR CORRECTION  DFC = FOR WET SAMPLES  DFCD = FOR DRY

     DF(J)=13.4/(  YC2(2,J) +(( YH(2,J) + CC(2,J))/10000.))
     DFC(J) = 1 - 1/DF(J)

C    CALCULATE DFC, VOL. KM FOR BAGS 1+2 AND 3+4
C    DF = TOTAL CVS FLOW / EXHAUST FLOW = AIR + EXH / EXH
C    DFC = 1 - 1/DF = 1 - EXH/(AIR+EXH) = AIR/(AIR+EXH)
     DFC12 =(DFC(1)*VMIX(1) + DFC(2)*VMIX(2)) / (VMIX(1) + VMIX(2))
     DFC34 = (DFC(3)*VMIX(3) + DFC(4)*VMIX(4)) / (VMIX(3) + VMIX(4))
     IF(RH.LT.20) RH = 20
     DFCD12 = DFC12 * (1.0 - 0.000323*(RH - 20))
     DFCD34 = DFC34 * (1.0 - 0.000323*(RH - 20))

C    SCF = SAMPLE CORRECTION FACTOR FOR WATER REMOVAL   SCF = FOR WET  SCFD=DRY
     SCF12 = 1.000
     SCF34 = 1.000
     SCFD12 = (SCFD(1)*VMIX(1)+SCFD(2)+VMIX(2)) / (VMIX(1) + VMIX(2))
     SCFD34 = (SCFD(3)*VMIX(3)+SCFD(4)*VMIX(4)) / (VMIX(3) + VMIX(4))
```

TOTAL FUEL SULFUR:

```
C    TFS = TOTAL FUEL SULFUR IN MG/KM
C    TFS = L/100KM * PCT  * G/ML * 1000ML/L * 0.01G/GPCT * 1000MG/G

     TFS = CBFM   * FSWPCT * FPPG * 100.

C    CALCULATE 4-BAG EMISSIONS AND FUEL CONSUMPTION
C    4-BAG = 0.43*(BAG1+BAG2)/(MILES1+MILES2)+0.57*(BAG3+BAG4)/(MILES3+MILES4)

     DISTA=MILES(1) + MILES(2)
     DISTB=MILES(2) + MILES(3)
     DISTC=MILES(3) + MILES(4)

     HCWM4 = 0.43*((HCM(1)+HCM(2)) / DISTA) + 0.57*((HCM(3)+HCM(4)) / DISTC)
     COWM4 = 0.43*((COM(1)+COM(2)) / DISTA) + 0.57*((COM(3)+COM(4)) / DISTC)
     CO2WM4= 0.43*((CO2M(1)+CO2M(2))/DISTA) + 0.57*((CO2M(3)+CO2M(4)) / DISTC)
     NOXWM4= 0.43*((NOXM(1)+NOXM(2))/DISTA) + 0.57*((NOXM(3)+NOXM(4)) / DISTC)
     CBFE4 = 2421. / (.866*HCWM4 + .429*COWM4 + .273*CO2WM4)
```

APPENDIX B

MALFUNCTION SCREENING EVALUATIONS

TABLE B-1. SUMMARY OF TASK 1 & 3 MALFUNCTION SCREENING
FTP RESULTS IN mg/km (EXCEPT AS NOTED)
1979 MERCURY MARQUIS WITH 351 "W" ENGINE

						DISABLED AIR PUMP		
	Unmod.	w/o O_2 Sensor	w/o CTS	w/o EGR Sensor	12% Misfire	w/o O_2	w/o CTS	w/o FCA
Test Number, PVM-ST	51A[a]	51B[a]	51C-2	51F-1	51M-1	51BH-1	51CH-2	51KH[a]
Barometer, mm Hg	744.3	743.7	741.7	753.1	738.9	749.0	739.9	742.0
Humidity, g/kg	7.2	8.5	10.6	4.4	7.5	4.6	6.5	7.0
Temperature, °C	24.5	24.8	26.7	25.6	24.4	23.9	23.9	25.9
Total Fuel Sulfur, mg/km	33.73	31.51	38.20	36.22	37.24	33.85	35.88	38.05
Avg. Exh. Oxygen, %	4.67	4.78	0.31	4.34	4.08	0.77	0.74	--
Catalyst Avg. Temp., °C	468	--	443	502	560	481	445	--
Catalyst Max. Temp., °C	540	--	553	639	769	584	588	541
Carbon Dioxide, g/km	367.2	345.4	329.2	394.0	404.6	355.6	321.5	298.6
Fuel Cons., ℓ/100 km	15.74	14.79	17.83	16.90	17.38	15.79	16.74	17.75
Regulated Emissions								
Hydrocarbons, (THC), g/km	0.12	0.09	1.53	0.14	0.50	0.52	1.54	2.29
Carbon Monoxide, g/km	0.74	0.49	53.21	0.98	0.62	8.14	41.87	70.06
Oxides of Nitrogen, g/km	0.79	2.93	1.89	2.90	0.75	2.05	1.90	0.41
Particulates								
Total Particulates	11.93	7.55	12.98	9.67	17.55	5.34	16.97	10.25
Sulfate	0.21	1.02	0.53	7.66	3.23	0.38	0.43	0.07
Sulfate as % of TFS, %	0.21	1.08	0.46	7.05	2.89	0.37	0.40	0.06
Compound Group Totals								
Aldehydes & Ketones	0.4	9.4	10.3	9.1	0.0	7.1	7.8	1.7
Individual Hydrocarbons	71.8	55.8	372.8	81.6	82.2	168.4	349.9	999.6
Organic Sulfides	0.02	0.23	0.00	0.56	0.23	0.77	0.00	0.51
Organic Amines	0.01	0.02	0.03	0.00	0.00	0.00	0.03	0.01
Other Compounds								
Ammonia	5.04	5.36	132.65	6.89	0.61	16.37	140.91	203.41
Cyanide & Cyanogen	0.08	--	49.29	0.00	0.04	6.69	26.07	35.45
Hydrogen Sulfide	0.03	0.00	0.45	0.00	0.11	0.14	0.35	1.06
Nickel Carbonyl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nitrous Oxide	23.89	16.32	73.17	103.63	--	43.93	60.43	17.09

[a] Average values for two tests

TABLE B-1 (Cont'd). SUMMARY OF TASK 1 & 3 MALFUNCTION SCREENING
FTP RESULTS IN mg/km (EXCEPT AS NOTED)
1979 MERCURY MARQUIS WITH 351 "W" ENGINE

	Unmod.	Sensor	CTS	Sensor	Misfire	DISABLED AIR PUMP w/o O_2	DISABLED AIR PUMP w/o CTS	DISABLED AIR PUMP w/o FCA
Test Number, PVM-ST	51A[a]	51B[a]	51C-2	51F-1	51M-1	51BH-1	51CH-2	51KH[a]
Aldehydes and Ketones	0.06	9.32	9.00	9.08	0.00	6.61	7.45	1.50
Formaldehyde	0.00	0.00	1.22	0.00	0.00	0.00	0.00	0.02
Acetaldehyde	0.18	0.00	0.04	0.00	0.00	0.00	0.19	0.00
Acetone	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.07
Isobutyraldehyde								
Methyl Ethyl Ketone	0.11	0.05	0.08	0.00	0.00	0.00	0.10	0.00
Crotonaldehyde	--	--	--	--	--	--	--	--
Hexanaldehyde	0.04	0.00	0.00	0.00	0.00	0.53	0.00	0.14
Benzaldehyde	--	--	--	--	--	--	--	--
Aldehydes and Ketones	0.4	9.4	10.3	9.1	0.0	7.1	7.8	1.7
Total as % of THC, %	0.3	11.2	0.7	6.5	0.0	1.4	0.5	0.1
Individual Hydrocarbons								
Methane	49.85	38.60	82.54	56.30	26.59	43.24	80.31	226.49
Ethylene	3.92	3.43	94.07	3.96	5.56	28.93	93.01	298.92
Ethane	6.42	3.67	12.56	6.42	2.20	7.94	11.89	27.17
Acetylene	1.92	1.55	1.98	1.36	1.95	2.49	1.60	8.30
Propane	0.36	0.17	1.57	1.69	0.49	0.79	0.99	2.88
Propylene	1.75	1.48	38.65	1.51	2.61	14.02	36.49	105.19
Benzene	2.53	2.28	53.51	3.84	12.75	30.79	48.92	120.07
Toluene	4.99	4.56	87.95	6.48	30.04	40.19	76.71	210.53
Total Individual HC	71.8	55.8	372.8	81.6	82.2	168.4	349.9	999.6
Total as % of THC, %	59.8	65.5	24.4	58.3	16.4	32.4	22.7	43.5
Organic Sulfides								
Carbonyl Sulfide	0.01	0.23	0.00	0.29	0.22	0.70	0.00	0.24
Methyl Sulfide	0.02	0.01	0.00	0.24	0.01	0.06	0.00	0.27
Ethyl Sulfide	0.00	0.00	0.00	0.02	0.00	0.01	0.00	0.00
Methyl Disulfide	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Organic Amines								
Monomethylamine	0.00	0.01	0.02	0.00	0.00	0.00	0.02	0.01
Monoethylamine	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.01
Trimethylamine	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diethylamine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Triethylamine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[a] Average values for two tests

TABLE B-1 (Cont'd). SUMMARY OF TASK 1 & 3 MALFUNCTION SCREENING
FTP RESULTS IN mg/km (EXCEPT AS NOTED)
1979 MERCURY MARQUIS WITH 351 "W" ENGINE

							DISABLED AIR PUMP		
		Unmod.	w/o O_2 Sensor	w/o CTS	w/o EGR Sensor	12% Misfire	w/o O_2	w/o CTS	w/o FCA
Test Number, PVM-ST		15A[a]	51B[a]	51C-2	51F-1	51M-1	51BH-1	51CH-2	51KH[a]
Trace Elements[b]									
Chromium	Cr								
Lead	Pb								
Manganese	Mn	0.01		0.02	0.01	0.01		0.02	
Arsenic	As								
Mercury	Hg								
Bromine	Br								
Phosphorus	P			0.10	0.03	0.01	0.01	0.05	
Silicon	Si	0.01		0.05	0.01	0.02		0.01	
Cadmium	Cd			0.02					
Aluminum	Al	0.06	0.01	0.08	0.06	0.07	0.02	0.05	0.03
Sulfur	S	0.12	0.43	0.20	2.96	1.25	0.07	0.13	0.04
Sodium	Na			0.03					
Fluorine	F								
Magnesium	Mg			0.01					
Potassium	K			0.01					
Chlorine	Cl	0.08	0.05	0.22	0.01	7.28	0.02	0.09	0.02
Platinum	Pt								
Zinc	Zn			0.11	0.04	0.01		0.05	
Copper	Cu								
Nickel	Ni								
Iron	Fe	1.23	0.19	1.53	1.41	2.49	0.65	0.91	0.39
Vanadium	V								
Titanium	Ti								
Barium	Ba	0.01		0.09	0.04	0.02	0.02	0.05	0.01
Calcium	Ca	0.02	0.01	0.10	0.06	0.02	0.02	0.05	0.01
Tin	Sn			0.01				0.01	

[a] Average values for two tests

[b] Values for all spaces left blank are 0.00

TABLE B-2. MALFUNCTION SCREENING REPEAT FTP RESULTS IN mg/km (EXCEPT AS NOTED) 1979 MERCURY MARQUIS WITH 351 "W" ENGINE

	UNMODIFIED		DISABLED O_2 SENSOR		DISABLED CTS and AIR PUMP		DISABLED FCA and AIR PUMP	
Test Number, PVM-ST	51A-1	51A-2	51B-1	51B-2	51CH-1	51CH-2	51KH-1	51KH-2
Barometer, mm Hg	742.2	746.3	749.8	737.6	738.9	739.9	743.5	740.4
Humidity, g/kg	6.6	7.7	3.9	13.0	12.7	6.5	4.8	9.2
Temperature, °C	25.0	23.9	22.8	26.7	25.6	23.9	25.0	26.7
Total Fuel Sulfur, mg/km	33.58	33.87	30.89	32.12	45.51	35.88	39.05	37.04
Avg. Exh. Oxygen, %	4.62	4.72	4.11	5.40	--	0.74	0.27	--
Catalyst Avg. Temp., °C	470	466	--	470	--	445	--	--
Catalyst Max. Temp., °C	538	542	--	578	550	588	538	544
Carbon Dioxide, g/km	366.1	368.3	340.1	350.6	292.9	321.5	307.1	290.1
Fuel Cons., ℓ/100 km	15.67	15.80	14.58	14.99	21.23	16.74	18.22	17.28
Regulated Emissions								
Hydrocarbons, (THC), g/km	0.12	0.12	0.09	0.08	3.78	1.54	2.31	2.26
Carbon Monoxide, g/km	0.43	1.04	0.75	0.22	122.56	41.87	71.58	68.53
Oxides of Nitrogen, g/km	0.86	0.71	2.57	3.28	1.91	1.90	0.37	0.45
Particulates								
Total Particulates	14.10	9.76	9.65	5.45	49.47	16.97	9.30	11.20
Sulfate	0.32	0.10	1.06	0.98	0.72	0.43	0.07	0.07
Sulfate as % of TFS, %	0.32	0.10	1.14	1.02	0.53	0.40	0.06	0.06
Compound Group Totals								
Aldehydes & Ketones	0.2	0.5	8.3	10.5	8.5	7.8	0.0	3.4
Individual Hydrocarbons	71.8	71.7	61.0	50.5	1396.4	349.9	1005.7	993.4
Organic Sulfides	0.04	0.00	0.25	0.21	0.01	0.00	0.92	
Organic Amines	0.02	0.00	0.02	0.01	0.01	0.03	0.00	0.02
Other Compounds								
Ammonia	9.13	0.95	8.13	2.59	48.71	140.91	218.09	189.73
Cyanide & Cyanogen	0.12	0.04	--	0.00	15.98	26.07	32.21	38.68
Hydrogen Sulfide	0.06	0.00	0.00	0.00	0.58	0.35	1.69	0.42
Nickel Carbonyl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nitrous Oxide	23.87	23.90	15.49	17.15	21.31	60.43	18.92	15.26

TABLE B-2 (Cont'd). MALFUNCTION SCREENING REPEAT FTP RESULTS
IN mg/km (EXCEPT AS NOTED
1979 MERCURY MARQUIS WITH 351 "W" ENGINE

	UNMODIFIED		DISABLED O_2 SENSOR		DISABLED CTS and AIR PUMP		DISABLED FCA and AIR PUMP	
Test Number, PVM-ST	51A-1	51A-2	51B-1	51B-2	51CH-1	51CH-2	51KH-1	51KH-2
Aldehydes and Ketones								
Formaldehyde	0.03	0.08	8.26	10.37	4.93	7.45	0.00	3.00
Acetaldehyde	0.00	0.00	0.00	0.00	2.93	0.00	0.00	0.04
Acetone	0.00	0.35	0.00	0.00	0.45	0.19	0.00	0.00
Isobutyraldehyde	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.13
Methyl Ethyl Ketone	0.11	0.11	0.00	0.10	0.18	0.10	0.00	0.00
Crotonaldehyde	--	--	--	--	--	--	--	--
Hexanaldehyde	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.27
Benzaldehyde	--	--	--	--	--	--	--	--
Aldehydes and Ketones	0.2	0.5	8.3	10.5	8.5	7.8	0.0	3.4
Total as % of THC, %	0.2	0.4	9.2	13.1	0.2	0.5	0.0	0.2
Individual Hydrocarbons								
Methane	49.56	50.14	42.53	34.66	490.58	80.31	218.99	233.98
Ethylene	3.56	4.27	3.86	3.00	451.03	93.01	296.43	301.40
Ethane	6.49	6.35	3.80	3.54	40.29	11.89	25.89	28.45
Acetylene	2.11	1.72	1.86	1.24	33.46	1.60	9.80	6.79
Propane	0.57	0.15	0.01	0.33	1.81	0.99	3.05	2.71
Propylene	1.77	1.73	1.44	1.51	62.64	36.49	108.64	101.73
Benzene	2.36	2.70	2.52	2.03	137.09	48.92	124.50	115.64
Toluene	5.36	4.62	4.95	4.17	179.53	76.71	218.36	202.69
Total Individual HC	71.8	71.7	61.0	50.5	1396.4	349.9	1005.7	993.4
Total as % of THC, %	59.8	59.8	67.8	63.1	36.9	22.7	43.0	44.0
Organic Sulfides								
Carbonyl Sulfide	0.01	0.00	0.25	0.20	0.00	0.00	0.39	0.09
Methyl Sulfide	0.03	0.00	0.00	0.01	0.01	0.00	0.53	0.00
Ethyl Sulfide	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Methyl Disulfide	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Organic Amines								
Monomethylamine	0.00	0.00	0.01	0.00	0.01	0.02	0.00	0.01
Monoethylamine	0.01	0.00	0.01	0.01	0.00	0.01	0.00	0.01
Trimethylamine	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diethylamine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Triethylamine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE B-2 (Cont'd). MALFUNCTION SCREENING REPEAT FTP RESULTS IN mg/km (EXCEPT AS NOTED)

1979 MERCURY MARQUIS WITH 351 "W" ENGINE

		UNMODIFIED		DISABLED O_2 SENSOR		DISABLED CTS and AIR PUMP		DISABLED FCA and AIR PUMP	
Test Number, PVM-ST		51A-1	51A-2	51B-1	51B-2	51CH-1	51CH-2	51KH-1	51KH-2
Trace Elements[a]									
Chromium	Cr								
Lead	Pb								
Manganese	Mn	0.01					0.02		
Arsenic	As								
Mercury	Hg								
Bromine	Br								
Phosphorus	P					0.02	0.05		
Silicon	Si	0.02				0.01	0.01		
Cadmium	Cd								
Aluminum	Al	0.11	0.01		0.01	0.05	0.05	0.02	0.03
Sulfur	S	0.16	0.07	0.41	0.44	0.17	0.13	0.02	0.05
Sodium	Na								
Fluorine	F								
Magnesium	Mg								
Potassium	K								
Chlorine	Cl	0.09	0.07	0.07	0.02	0.07	0.09		0.03
Platinum	Pt								
Zinc	Zn						0.05		
Copper	Cu								
Nickel	Ni								
Iron	Fe	2.22	0.24	0.18	0.19	0.96	0.91	0.12	0.65
Vanadium	V								
Titanium	Ti								
Barium	Ba	0.01	0.01			0.02	0.05		0.01
Calcium	Ca	0.02	0.02	0.01	0.01	0.02	0.05	0.01	0.01
Tin							0.01		

[a] Values for all spaces left blank are 0.00

TABLE B-3. FTP INDIVIDUAL SAMPLE EMISSIONS RESULTS

	Emissions in mg/km			
	51A-1 Unmodified		51A-2 Unmodified	
	COLD-UDDS	HOT-UDDS	COLD-UDDS	HOT-UDDS
Total Particulate	19.53	10.01	5.58	12.92
Sulfates	0.37	0.29	0.08	0.11
Ammonia	14.88	4.80	0.19	1.53
Cyanides & Cyanogen	0.29	0.00	0.00	0.00
Hydrogen Sulfide	0.11	0.02	0.00	0.00
Aldehydes & Ketones				
Formaldehyde	0.00	0.00	0.12	0.05
Acetaldehyde	0.00	0.00	0.00	0.00
Acetone	0.00	0.00	0.75	0.05
Isobutyraldehyde	0.00	0.00	0.00	0.00
Methyl ethyl ketone	0.11	0.11	0.19	0.06
Crotonaldehyde	--	--	--	--
Hexanaldehyde	0.01	0.14	0.00	0.00
Benzaldehyde	--	--	--	--
Organic Sulfides				
Carbonyl sulfide	0.00	0.01	0.00	0.00
Methyl sulfide	0.02	0.03	0.00	0.00
Ethyl sulfide	0.00	0.00	0.00	0.00
Methyl disulfide	0.00	0.00	0.00	0.00
Organic Amines				
Monomethylamine	0.00	0.00	0.00	0.00
Monoethylamine & dimethylamine	0.00	0.01	0.00	0.00
Trimethylamine	0.00	0.01	0.00	0.00
Diethylamine	0.00	0.00	0.00	0.00
Triethylamine	0.00	0.00	0.00	0.00

TABLE B-4. FTP INDIVIDUAL SAMPLE EMISSIONS RESULTS

	Emissions in mg/km			
	51B-1 Without O_2 Sensor		51B-2 Without O_2 Sensor	
	COLD-UDDS	HOT-UDDS	COLD-UDDS	HOT-UDDS
Total Particulate	10.77	9.01	10.82	1.40
Sulfates	1.68	0.60	0.18	1.59
Ammonia	11.36	5.85	3.22	2.11
Cyanides & Cyanogen	--	--	0.00	0.00
Hydrogen Sulfide	0.00	0.00	0.00	0.00
Aldehydes & Ketones				
Formaldehyde	8.44	8.17	10.20	10.49
Acetaldehyde	0.00	0.00	0.00	0.00
Acetone	0.00	0.00	0.00	0.00
Isobutyraldehyde	0.00	0.00	0.00	0.00
Methyl ethyl ketone	0.00	0.00	0.13	0.08
Crotonaldehyde	--	--	--	--
Hexanaldehyde	0.00	0.00	0.00	0.00
Benzaldehyde	--	--	--	--
Organic Sulfides				
Carbonyl sulfide	0.00	0.43	0.47	0.00
Methyl sulfide	0.00	0.00	0.03	0.00
Ethyl sulfide	0.00	0.00	0.00	0.00
Methyl disulfide	0.00	0.00	0.00	0.00
Organic Amines				
Monomethylamine	0.00	0.02	0.00	0.00
Monoethylamine & dimethylamine	0.00	0.01	0.00	0.01
Trimethylamine	0.00	0.00	0.00	0.00
Diethylamine	0.00	0.00	0.00	0.00
Triethylamine	0.00	0.00	0.00	0.00

TABLE B-5 . FTP INDIVIDUAL SAMPLE EMISSIONS RESULTS

	Emissions in mg/km			
	51C-2 Without CTS		51F-1 Without EGR Sensor	
	COLD-UDDS	HOT-UDDS	COLD-UDDS	HOT-UDDS
Total Particulate	5.67	18.50	12.02	7.89
Sulfates	0.62	0.47	8.04	7.38
Ammonia	239.09	52.36	11.55	3.37
Cyanides & Cyanogen	110.03	3.46	0.00	0.00
Hydrogen Sulfide	0.96	0.06	0.00	0.00
Aldehydes & Ketones				
Formaldehyde	0.07	15.74	9.36	8.86
Acetaldehyde	2.83	0.00	0.00	0.00
Acetone	0.10	0.00	0.00	0.00
Isobutyraldehyde	0.00	0.00	0.00	0.00
Methyl ethyl ketone	0.05	0.11	0.00	0.00
Crotonaldehyde	--	--	--	--
Hexanaldehyde	0.00	0.00	0.00	0.00
Benzaldehyde	--	--	--	--
Organic Sulfides				
Carbonyl sulfide	0.00	0.00	0.34	0.25
Methyl sulfide	0.00	0.00	0.40	0.12
Ethyl sulfide	0.00	0.00	0.04	0.01
Methyl disulfide	0.00	0.00	0.02	0.00
Organic Amines				
Monomethylamine	0.03	0.01	0.00	0.00
Monoethylamine & dimethylamine	0.00	0.01	0.00	0.00
Trimethylamine	0.00	0.00	0.00	0.00
Diethylamine	0.00	0.00	0.00	0.00
Triethylamine	0.00	0.00	0.00	0.00

TABLE B-6 . FTP INDIVIDUAL SAMPLE EMISSIONS RESULTS

	Emissions in mg/km			
	51M-1 12 Percent Misfire		51BH-1 Disabled Air Pump Without O_2	
	COLD-UDDS	HOT-UDDS	COLD-UDDS	HOT-UDDS
Total Particulate	24.13	12.58	6.41	4.53
Sulfates	2.73	3.60	0.39	0.38
Ammonia	1.41	0.00	10.23	21.01
Cyanides & Cyanogen	0.02	0.06	15.56	0.00
Hydrogen Sulfide	0.04	0.17	0.21	0.09
Aldehydes & Ketones				
Formaldehyde	0.00	0.00	5.73	7.28
Acetaldehyde	0.00	0.00	0.00	0.00
Acetone	0.00	0.00	0.00	0.00
Isobutyraldehyde	0.00	0.00	0.00	0.00
Methyl ethyl ketone	0.00	0.00	0.00	0.00
Crotonaldehyde	--	--	--	--
Hexanaldehyde	0.00	0.00	1.04	0.14
Benzaldehyde	--	--	--	--
Organic Sulfides				
Carbonyl sulfide	0.53	0.00	1.41	0.17
Methyl sulfide	0.00	0.01	0.00	0.10
Ethyl sulfide	0.00	0.00	0.02	0.00
Methyl disulfide	0.00	0.00	0.00	0.00
Organic Amines				
Monomethylamine	0.00	0.00	0.01	0.00
Monoethylamine & dimethylamine	0.01	0.00	0.00	0.00
Trimethylamine	0.00	0.00	0.00	0.00
Diethylamine	0.00	0.00	0.00	0.00
Triethylamine	0.00	0.00	0.00	0.00

TABLE B-7 . FTP INDIVIDUAL SAMPLE EMISSIONS RESULTS

	Emissions in mg/km			
	51CH-1 Disabled Air Pump Without CTS		51CH-2 Disabled Air Pump Without CTS	
	COLD-UUDS	HOT-UDDS	COLD-UDDS	HOT-UDDS
Total Particulate	79.10	27.12	16.67	17.19
Sulfates	0.82	0.63	0.33	0.50
Ammonia	80.86	24.45	254.68	55.09
Cyanides & Cyanogen	36.57	0.44	60.05	0.44
Hydrogen Sulfide	1.35	0.00	0.82	0.00
Aldehydes & Ketones				
Formaldehyde	0.99	7.90	0.00	13.07
Acetaldehyde	6.82	0.00	0.00	0.00
Acetone	0.80	0.18	0.44	0.00
Isobutyraldehyde	0.00	0.00	0.00	0.16
Methyl ethyl ketone	0.06	0.27	0.16	0.06
Crotonaldehyde	--	--	--	--
Hexanaldehyde	0.00	0.00	0.00	0.00
Benzaldehyde	--	--	--	--
Organic Sulfides				
Carbonyl sulfide	0.00	0.00	0.00	0.00
Methyl sulfide	0.00	0.01	0.00	0.00
Ethyl sulfide	0.00	0.00	0.00	0.00
Methyl disulfide	0.00	0.00	0.00	0.00
Organic Amines				
Monomethylamine	0.00	0.01	0.04	0.01
Monoethylamine & dimethylamine	0.00	0.00	0.02	0.01
Trimethylamine	0.00	0.00	0.00	0.00
Diethylamine	0.00	0.00	0.00	0.00
Triethylamine	0.00	0.00	0.00	0.00

TABLE B-8 . FTP INDIVIDUAL SAMPLE EMISSIONS RESULTS

	Emissions in mg/km			
	51KH-1 Disabled Air Pump Without FCA		51KH-2 Disabled Air Pump Without FCA	
	COLD-UDDS	HOT-UDDS	COLD-UDDS	HOT-UDDS
Total Particulate	12.16	7.15	11.27	11.14
Sulfates	0.16	0.01	0.10	0.05
Ammonia	204.49	228.35	184.91	193.37
Cyanides & Cyanogen	6.33	51.74	28.31	46.51
Hydrogen Sulfide	1.74	1.66	0.33	0.49
Aldehydes & ketones				
Formaldehyde	0.00	0.00	0.00	0.00
Acetaldehyde	0.00	0.00	3.01	3.06
Acetone	0.00	0.00	0.00	0.00
Isobutyraldehyde	0.00	0.00	0.00	0.22
Methyl ethyl ketone	0.00	0.00	0.00	0.00
Crotonaldehyde	--	--	--	--
Hexanaldehyde	0.00	0.00	0.26	0.27
Benzaldehyde	--	--	--	--
Organic Sulfides				
Carbonyl sulfide	0.36	0.41	0.02	0.14
Methyl sulfide	0.03	0.91	0.00	0.00
Ethyl sulfide	0.00	0.00	0.00	0.00
Methyl disulfide	0.00	0.00	0.00	0.00
Organic Amines				
Monomethylamine	0.00	0.00	0.02	0.01
Monoethylamine & dimethylamine	0.00	0.00	0.00	0.01
Trimethylamine	0.00	0.00	0.00	0.00
Diethylamine	0.00	0.00	0.00	0.00
Triethylamine	0.00	0.00	0.00	0.00

TABLE B-9. TEST NO. 51A-1 EMISSIONS RESULTS

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                                     PVM - 51A   FTP   VEHICLE EMISSIONS RESULTS - UNMODIFIED
                                                       PROJECT 11-5402-001

TEST NO.    51A-1     RUN   1                      VEHICLE NO.    51                      TEST WEIGHT    2041 KG(  4500 LBS)
VEHICLE MODEL    79 MERCURY MARQUIS                DATE     3/ 1/79                       ACTUAL ROAD LOAD    8.9 KW( 12.0 HP)
ENGINF 5.7 L(351 CID) V-8                          BAG CART NO.  1                        GASOLINE  EM-344
TRANSMISSION A3                                    DYNO NO.      3                        ODOMETER    1444 KM(    897 MILES)
GVW  2434 KG(  5365 LBS)                           CVS NO.       2

BAROMETER 742.19 MM HG(29.22 IN HG)                DRY BULB TEMP. 25.0 DEG C(77.0 DEG F)
RELATIVE HUMIDITY 33 PCT                           ABS. HUMIDITY  6.6 GM/KG               NOX HUMIDITY CORRECTION FACTOR    .88
BAG RESULTS
   BAG NUMBER                                      1                  2                  3                  4
   DESCRIPTION                              COLD TRANSIENT       STABILIZED        HOT TRANSIENT       STABILIZED

   BLOWER DIF P MM. H2O(IN. H2O)            762.0 (30.0)       762.0 (30.0)       762.0 (30.0)       762.0 (30.0)
   HLOWER INLET P MM. H2O(IN. H2O)          736.6 (29.0)       736.6 (29.0)       736.6 (29.0)       736.6 (29.0)
   BLOWER INLET TEMP. DEG. C(DEG. F)         43.3 (110.0)       43.3 (110.0)       43.3 (110.0)       42.2 (108.0)
   BLOWER REVOLUTIONS                           40697              69693              40620              69631
   CVS FLOW STD. CU. METRES(SCF)             76.0 (2683.3)     130.1 (4594.4)      75.8 (2677.9)     130.2 (4599.3)
   HC  SAMPLE METER/RANGE/PPM               50.2/ 2/   50      15.9/ 2/   16      23.9/ 2/   24      15.9/ 2/   16
   HC  BCKGRD METER/RANGE/PPM               12.1/ 2/   12      11.3/ 2/   11      13.1/ 2/   13      12.7/ 2/   13
   CO  SAMPLE METER/RANGE/PPM               49.6/12/  109       7.1/13/    7      12.8/13/   12       6.6/13/    6
   CO  BCKGRD METER/RANGE/PPM                2.1/12/    4       2.0/13/    2       1.2/13/    1       1.6/13/    2
   CO2 SAMPLE METER/RANGE/PCT               86.8/ 3/ 1.61      56.8/ 3/ 1.00      80.7/ 3/ 1.48      59.4/ 3/ 1.05
   CO2 BCKGRD METER/RANGE/PCT                3.6/ 3/  .06       3.5/ 3/  .05       3.5/ 3/  .05       3.2/ 3/  .05
   NOX SAMPLE METER/RANGE/PPM               78.2/ 2/   78      15.8/ 2/   16      38.4/ 2/   38      16.9/ 2/   17
   NOX BCKGRD METER/RANGE/PPM                1.1/ 2/    1       1.2/ 2/    1       1.1/ 2/    1       1.1/ 2/    1
   DILUTION FACTOR                               8.24              13.37               9.01              12.72

   HC  CONCENTRATION PPM                          40                  5                 12                  4
   CO  CONCENTRATION PPM                         102                  5                 11                  5
   CO2 CONCENTRATION PCT                        1.56                .95               1.44               1.01
   NOX CONCENTRATION PPM                        77.2               14.7               37.4               15.9
   HC  MASS GRAMS                               1.73                .41                .54                .32
   CO  MASS GRAMS                               8.98                .74                .95                .73
   CO2 MASS GRAMS                             2174.2             2263.2             1994.6             2398.8
   NOX MASS GRAMS                               9.89               3.22               4.78               3.49

   HC  GRAMS/KM                                  .30                .07                .09                .05
   CO  GRAMS/KM                                 1.55                .12                .16                .12
   CO2 GRAMS/KM                                375.4              368.0              345.0              389.1
   NOX GRAMS/KM                                 1.71                .52                .83                .57
   FUEL CONSUMPTION BY CB L/100KM              16.17              15.72              14.75              16.62

   RUN TIME               SECONDS                505                867                505                867
   AVG. EXH. OXYGEN       PERCENT               4.97               4.60               4.42               4.41
   CATALYST AVG. TEMP.    DEG. C                 384                497                453                497
   CATALYST MAX. TEMP.    DEG. C                 525                533                538                525
   MEASURED DISTANCE      KM                    5.79               6.15               5.78               6.16
        DFC, WET (DRY)                                 .908 ( .904)                          .909 ( .906)
        SCF, WET (DRY)                                1.000 ( .985)                         1.000 ( .985)
        VOL (SCM)                                            206.1                                 206.0
        KM  (MEASURED)                                       11.94                                 11.95

COMPOSITE RESULTS                                                                                     3-BAG        (4-BAG)
   TEST NUMBER             51A-1        TOTAL FUEL SULFUR    MG/KM    33.32      CARBON DIOXIDE       G/KM      363.2      ( 369.4)
   BAROMETER     MM HG    742.2         AVG. FXH. OXYGEN     PCT       4.62      FUEL CONSUMPTION     L/100KM    15.55      ( 15.81)
   HUMIDITY      G/KG       6.6         CATALYST AVG. TEMP.  DEG C      470      HYDROCARBONS (THC)   G/KM         .12      (   .12)
   TEMPERATURE   DEG C     25.0         CATALYST MAX. TEMP.  DEG C      538      CARBON MONOXIDE      G/KM         .43      (   .43)
                                                                                 OXIDES OF NITROGEN   G/KM         .85      (   .87)
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TABLE B-10. TEST NO. 51A-2 EMISSIONS RESULTS

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                         PVM - 51A   FTP  VEHICLE EMISSIONS RESULTS - UNMODIFIED
                                            PROJECT 11-5402-001

TEST NO.   51A-2    RUN   1                  VEHICLE NO.   51               TEST WEIGHT   2041 KG(  4500 LBS)
VEHICLE MODEL   79 MERCURY MARQUIS           DATE    3/16/79                ACTUAL ROAD LOAD   8.9 KW( 12.0 HP)
ENGINE 5.7 L(351 CID) V-8                    BAG CART NO.  1                GASOLINE  EM-344
TRANSMISSION A3                              DYNO NO.      3                ODOMETER   1572 KM(   977 MILES)
GVW  2934 KG(  5365 LBS)                     CVS NO.       2

BAROMETER 746.25 MM HG(29.38 IN HG)          DRY BULB TEMP. 23.9 DEG C(75.0 DEG F)
RELATIVE HUMIDITY 41 PCT                     ABS. HUMIDITY  7.7 GM/KG       NOX HUMIDITY CORRECTION FACTOR   .91
BAG RESULTS
  BAG NUMBER                                       1                  2                  3                  4
  DESCRIPTION                               COLD TRANSIENT       STABILIZED        HOT TRANSIENT        STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)             774.7 (30.5)       774.7 (30.5)       774.7 (30.5)       774.7 (30.5)
  BLOWER INLET P MM. H2O(IN. H2O)           762.0 (30.0)       762.0 (30.0)       762.0 (30.0)       762.0 (30.0)
  BLOWER INLET TEMP. DEG. C(DEG. F)          43.3 (110.0)       43.3 (110.0)       43.3 (110.0)       43.3 (110.0)
  BLOWER REVOLUTIONS                           40674              69881              40551              69790
  CVS FLOW STD. CU. METRES(SCF)             76.7 (2710.6)     131.8 (4656.5)      76.5 (2702.1)     131.7 (4650.2)
  HC   SAMPLE METER/RANGE/PPM               54.2/ 2/   54      12.4/ 2/   12      15.5/ 2/   15      11.7/ 2/   12
  HC   BCKGRD METER/RANGE/PPM                6.9/ 2/    7       8.7/ 2/    9       7.1/ 2/    7       7.4/ 2/    7
  CO   SAMPLE METER/RANGE/PPM               71.3/11/  307       6.9/13/    7      19.4/13/   18       5.8/13/    6
  CO   BCKGRD METER/RANGE/PPM                2.3/11/    7       3.6/13/    4       2.5/13/    2       2.0/13/    2
  CO2  SAMPLE METER/RANGE/PCT               84.4/ 3/ 1.56      58.1/ 3/ 1.03      78.2/ 3/ 1.43      56.7/ 3/ 1.00
  CO2  BCKGRD METER/RANGE/PCT                3.3/ 3/  .05       3.7/ 3/  .06       3.3/ 3/  .05       3.5/ 3/  .05
  NOX  SAMPLE METER/RANGE/PPM               54.5/ 2/   54      14.1/ 2/   14      32.2/ 2/   32      14.0/ 2/   14
  NOX  BCKGRD METER/RANGE/PPM                1.0/ 2/    1       1.0/ 2/    1       1.2/ 2/    1       1.1/ 2/    1
  DILUTION FACTOR                               8.40              13.05               9.33              13.41

  HC   CONCENTRATION PPM                          48                  4                  9                  5
  CO   CONCENTRATION PPM                         287                  3                 16                  4
  CO2  CONCENTRATION PCT                        1.52                .97               1.39                .95
  NOX  CONCENTRATION PPM                        53.6               13.2               31.1               13.0
  HC   MASS GRAMS                               2.13                .33                .40                .37
  CO   MASS GRAMS                              25.69                .50               1.39                .56
  CO2  MASS GRAMS                             2131.6             2349.0             1943.7             2285.8
  NOX  MASS GRAMS                               7.15               3.02               4.14               2.97

  HC   GRAMS/KM                                  .37                .05                .07                .06
  CO   GRAMS/KM                                 4.48                .08                .24                .09
  CO2  GRAMS/KM                                371.3              383.0              338.3              372.7
  NOX  GRAMS/KM                                 1.25                .49                .72                .48
  FUEL CONSUMPTION BY CB L/100KM               16.20              16.36              14.47              15.92

  RUN TIME              SECONDS                  505                870                504                870
  AVG. EXH. OXYGEN      PERCENT                 4.45               4.78               4.73               4.68
  CATALYST AVG. TEMP.   DEG. C                   413                485                449                490
  CATALYST MAX. TEMP.   DEG. C                   542                521                538                538
  MEASURED DISTANCE     KM                      5.74               6.13               5.74               6.13
      DFC, WET (DRY)                                 .908 ( .902)                          .913 ( .907)
      SCF, WET (DRY)                                1.000 ( .982)                         1.000 ( .983)
      VOL (SCM)                                             208.6                                 208.2
      KM  (MEASURED)                                        11.87                                 11.88

COMPOSITE RESULTS                                                                                 3-BAG        (4-BAG)
  TEST NUMBER           51A-2      TOTAL FUEL SULFUR    MG/KM   33.87   CARBON DIOXIDE       G/KM     368.3     ( 365.2)
  BAROMETER   MM HG     746.3      AVG. EXH. OXYGEN     PCT      4.72   FUEL CONSUMPTION     L/100KM  15.80     ( 15.68)
  HUMIDITY    G/KG        7.7      CATALYST AVG. TEMP. DEG C      466   HYDROCARBONS (THC)   G/KM       .12     (   .13)
  TEMPERATURE DEG C      23.9      CATALYST MAX. TEMP. DEG C      542   CARBON MONOXIDE      G/KM      1.04     (  1.04)
                                                                        OXIDES OF NITROGEN   G/KM       .71     (   .71)
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TABLE B-11. TEST NO. 51B-1 EMISSIONS RESULTS

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                    PVM - 51B   FTP  VEHICLE EMISSIONS RESULTS - DISABLED O2 SENSOR
                                          PROJECT 11-5402-001

TEST NO.   51B1      RUN   1                 VEHICLE NO.   51                  TEST WEIGHT   2041 KG( 4500 LBS)
VEHICLE MODEL   79 MERCURY MARQUIS           DATE     2/19/79                  ACTUAL ROAD LOAD   8.9 KW( 12.0 HP)
ENGINE 5.7 L(351 CID) V-8                    BAG CART NO.  1                   GASOLINE  EM-344
TRANSMISSION A3                              DYNO NO.      3                   ODOMETER   1231 KM(   765 MILES)
GVW  2434 KG(  5365 LBS)                     CVS NO.       2

BAROMETER 749.81 MM HG(29.52 IN HG)          DRY BULB TEMP. 22.8 DEG C(73.0 DEG F)
RELATIVE HUMIDITY 23 PCT                     ABS. HUMIDITY  3.9 GM/KG          NOX HUMIDITY CORRECTION FACTOR   .82
BAG RESULTS
  BAG NUMBER                                   1                  2                  3                  4
  DESCRIPTION                            COLD TRANSIENT       STABILIZED       HOT TRANSIENT        STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)          787.4 (31.0)       787.4 (31.0)       787.4 (31.0)       787.4 (31.0)
  BLOWER INLET P MM. H2O(IN. H2O)        762.0 (30.0)       762.0 (30.0)       762.0 (30.0)       762.0 (30.0)
  BLOWER INLET TEMP. DEG. C(DEG. F)       42.8 (109.0)       43.3 (110.0)       43.3 (110.0)       43.3 (110.0)
  BLOWER REVOLUTIONS                        40714              69731              40697              69680
  CVS FLOW STD. CU. METRES(SCF)           77.3 (2729.0)     132.2 (4668.9)      77.2 (2724.9)     132.1 (4665.3)
  HC  SAMPLE METER/RANGE/PPM             41.7/ 2/   42      13.6/ 2/   14      14.9/ 2/   15      10.3/ 2/   10
  HC  BCKGRD METER/RANGE/PPM             11.6/ 2/   12      10.3/ 2/   10       8.5/ 2/    9       8.5/ 2/    9
  CO  SAMPLE METER/RANGE/PPM             93.6/12/  229      11.9/13/   11      18.7/13/   18       5.8/13/    6
  CO  BCKGRD METER/RANGE/PPM              7.1/12/   13      10.4/13/   10       5.0/13/    5       4.3/13/    4
  CO2 SAMPLE METER/RANGE/PCT             77.9/ 3/ 1.43      56.0/ 3/  .98      71.1/ 3/ 1.29      54.7/ 3/  .96
  CO2 BCKGRD METER/RANGE/PCT              3.3/ 3/  .05       3.5/ 3/  .05       3.4/ 3/  .05       3.6/ 3/  .06
  NOX SAMPLE METER/RANGE/PPM             49.2/ 3/  148      60.4/ 2/   60      54.8/ 3/  164      79.6/ 2/   80
  NOX BCKGRD METER/RANGE/PPM               .6/ 3/    2       1.4/ 2/    1        .6/ 3/    2       1.7/ 2/    2
  DILUTION FACTOR                            9.23              13.58              10.39              13.96

  HC  CONCENTRATION PPM                      31                 4                  7                  2
  CO  CONCENTRATION PPM                     210                 2                 13                  2
  CO2 CONCENTRATION PCT                    1.38               .93               1.24                .91
  NOX CONCENTRATION PPM                   146.0              59.1              162.8               78.0
  HC  MASS GRAMS                           1.40               .31                .32                .18
  CO  MASS GRAMS                          18.85               .30               1.16                .25
  CO2 MASS GRAMS                         1954.3            2261.6             1751.3             2194.5
  NOX MASS GRAMS                          17.64             12.22              19.64              16.12

  HC  GRAMS/KM                              .24               .05                .06                .03
  CO  GRAMS/KM                             3.23               .05                .20                .04
  CO2 GRAMS/KM                            334.8             363.3              300.7              351.5
  NOX GRAMS/KM                             3.02              1.96               3.37               2.58
  FUEL CONSUMPTION BY CB L/100KM          14.54             15.51              12.85              15.01

  RUN TIME               SECONDS            505               867                506                868
  AVG. EXH. OXYGEN       PERCENT           4.12              3.96               4.58               4.70
  CATALYST AVG. TEMP.    DEG. C              -                 -                  -                  -
  CATALYST MAX. TEMP.    DEG. C              -                 -                  -                  -
  MEASURED DISTANCE      KM                5.84              6.23               5.82               6.24
       DFC, WET (DRY)                              .914 ( .913)                          .919 ( .918)
       SCF, WET (DRY)                             1.000 ( .989)                         1.000 ( .989)
       VOL (SCM)                                        209.5                                 209.2
       KM  (MEASURED)                                   12.06                                 12.07

COMPOSITE RESULTS                                                                                3-BAG       (4-BAG)
  TEST NUMBER          51B1         TOTAL FUEL SULFUR   MG/KM    31.24    CARBON DIOXIDE      G/KM      340.1      ( 336.7)
  BAROMETER    MM HG  749.8         AVG. EXH. OXYGEN    PCT       4.11    FUEL CONSUMPTION    L/100KM    14.58     ( 14.43)
  HUMIDITY     G/KG     3.9         CATALYST AVG. TEMP. DEG C      -      HYDROCARBONS (THC)  G/KM        .09     (   .08)
  TEMPERATURE  DEG C   22.8         CATALYST MAX. TEMP. DEG C      -      CARBON MONOXIDE     G/KM        .75     (   .75)
                                                                          OXIDES OF NITROGEN  G/KM       2.57     (  2.75)
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TABLE B-12. TEST NO. 51B-2 EMISSIONS RESULTS

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                    PVM - 51B   FTP  VEHICLE EMISSIONS RESULTS - DISABLED O SENSOR
                                       PROJECT 11-5402-001

TEST NO.   51B-2    RUN   1                VEHICLE NO.   51            TEST WEIGHT   2041 KG(  4500 LBS)
VEHICLE MODEL   79 MERCURY MARQUIS         DATE    3/19/79             ACTUAL ROAD LOAD   8.9 KW( 12.0 HP)
ENGINE 5.7 L(351 CID) V-8                  BAG CART NO.  1             GASOLINE   EM-344
TRANSMISSION A3                            DYNO NO.      3             ODOMETER    1608 KM(    999 MILES)
GVW  2434 KG(  5365 LBS)                   CVS NO.       2

BARometer 737.62 MM HG(29.04 IN HG)        DRY BULB TEMP. 26.7 DEG C(80.0 DEG F)
RELATIVE HUMIDITY 58 PCT                   ABS. HUMIDITY 13.0 GM/KG           NOX HUMIDITY CORRECTION FACTOR  1.08
BAG RESULTS
  BAG NUMBER                                     1                  2                  3                  4
  DESCRIPTION                              COLD TRANSIENT       STABILIZED        HOT TRANSIENT        STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)             762.0 (30.0)       762.0 (30.0)       762.0 (30.0)       762.0 (30.0)
  BLOWER INLET P MM. H2O(IN. H2O)           736.6 (29.0)       736.6 (29.0)       736.6 (29.0)       736.6 (29.0)
  BLOWER INLET TEMP. DEG. C(DEG. F)          44.4 (112.0)       43.9 (111.0)       46.1 (115.0)       46.1 (115.0)
  BLOWER REVOLUTIONS                            40768              69694              40664              69614
  CVS FLOW STD. CU. METRES(SCF)              76.0 (2686.1)     130.1 (4595.4)      76.0 (2685.6)     130.2 (4597.1)
  HC   SAMPLE METER/RANGE/PPM               38.5/ 2/   38       9.5/ 2/   10      16.4/ 2/   16      14.4/ 2/   14
  HC   BCKGRD METER/RANGE/PPM                8.1/ 2/    8       8.0/ 2/    8       8.4/ 2/    8       9.3/ 2/    9
  CO   SAMPLE METER/RANGE/PPM               64.1/13/   62       8.8/13/    9      11.7/13/   11       6.1/13/    6
  CO   BCKGRD METER/RANGE/PPM                8.2/13/    8       6.7/13/    7       4.6/13/    4       3.5/13/    3
  CO2  SAMPLE METER/RANGE/PCT               82.0/ 3/ 1.51      55.3/ 3/  .97      81.0/ 3/ 1.49      58.0/ 3/ 1.02
  CO2  BCKGRD METER/RANGE/PCT                3.5/ 3/  .05       3.9/ 3/  .06       3.9/ 3/  .06       3.8/ 3/  .06
  NOX  SAMPLE METER/RANGE/PPM               50.0/ 3/  150      64.8/ 2/   65      46.0/ 3/  138      59.6/ 2/   60
  NOX  BCKGRD METER/RANGE/PPM                1.3/ 3/    4       1.4/ 2/    1        .6/ 3/    2       1.6/ 2/    2
  DILUTION FACTOR                                8.81              13.79               8.97              13.07

  HC   CONCENTRATION PPM                           31                  2                  9                  6
  CO   CONCENTRATION PPM                           52                  2                  7                  3
  CO2  CONCENTRATION PCT                         1.46                .91               1.44                .97
  NOX  CONCENTRATION PPM                        146.5               63.5              136.4               58.1
  HC   MASS GRAMS                                1.37                .16                .39                .44
  CO   MASS GRAMS                                4.62                .34                .60                .39
  CO2  MASS GRAMS                              2038.5             2179.4             2001.4             2310.9
  NOX  MASS GRAMS                               23.05              17.09              21.45              15.65

  HC   GRAMS/KM                                   .24                .03                .07                .07
  CO   GRAMS/KM                                   .80                .06                .10                .06
  CO2  GRAMS/KM                                 351.9              352.1              346.8              372.4
  NOX  GRAMS/KM                                  3.98               2.76               3.72               2.52
  FUEL CONSUMPTION BY CB L/100KM                15.11              15.04              14.82              15.91

  RUN TIME              SECONDS                   505                867                505                868
  AVG. EXH. OXYGEN      PERCENT                  5.83               5.72               4.10               4.04
  CATALYST AVG. TEMP.   DEG. C                    398                479                497                536
  CATALYST MAX. TEMP.   DEG. C                    546                512                578                567
  MEASURED DISTANCE     KM                       5.79               6.19               5.77               6.21
      DFC, WET (DRY)                                  .912 ( .901)                          .911 ( .900)
      SCF, WET (DRY)                                 1.000 ( .977)                         1.000 ( .977)
      VOL (SCM)                                              206.2                                 206.2
      KM  (MEASURED)                                         11.98                                 11.98

COMPOSITE RESULTS                                                                                  3-BAG      (4-BAG)
  TEST NUMBER           51B-2     TOTAL FUEL SULFUR    MG/KM   32.12    CARBON DIOXIDE      G/KM      350.6     ( 356.6)
  BAROMETER    MM HG    737.6     AVG. EXH. OXYGEN     PCT      5.40    FUEL CONSUMPTION    L/100KM   14.99     ( 15.25)
  HUMIDITY     G/KG      13.0     CATALYST AVG. TEMP. DEG C      470    HYDROCARBONS (THC)  G/KM        .08     (   .09)
  TEMPERATURE  DEG C     26.7     CATALYST MAX. TEMP. DEG C      578    CARBON MONOXIDE     G/KM        .22     (   .23)
                                                                        OXIDES OF NITROGEN  G/KM       3.28     (  3.21)
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TABLE B-13. TEST NO. 51C-2 EMISSIONS RESULTS

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                     PVM - 51C   FTP  VEHICLE EMISSIONS RESULTS - DISABLED CTS
                                      PROJECT 11-5402-001

TEST NO.   51C-2    RUN   1                VEHICLE NO.   51                TEST WEIGHT    2041 KG(  4500 LBS)
VEHICLE MODEL   79 MERCURY MARQUIS         DATE    3/21/79                 ACTUAL ROAD LOAD    8.9 KW( 12.0 HP)
ENGINE 5.7 L(351 CID) V-8                  BAG CART NO.  2                 GASOLINE  EM-344
TRANSMISSION A3                            DYNO NO.      3                 ODOMETER         0 KM(     -0 MILES)
GVW  2434 KG(  5365 LBS)                   CVS NO.       2

BAROMETER 741.68 MM HG(29.20 IN HG)        DRY BULB TEMP. 26.7 DEG C(80.0 DEG F)
RELATIVE HUMIDITY 48 PCT                   ABS. HUMIDITY 10.6 GM/KG        NOX HUMIDITY CORRECTION FACTOR  1.00
BAG RESULTS
  BAG NUMBER                                     1                  2                  3                  4
  DESCRIPTION                             COLD TRANSIENT       STABILIZED        HOT TRANSIENT        STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)           774.7 (30.5)       762.0 (30.0)       762.0 (30.0)       787.4 (31.0)
  BLOWER INLET P MM. H2O(IN. H2O)         762.0 (30.0)       787.4 (31.0)       787.4 (31.0)       762.0 (30.0)
  BLOWER INLET TEMP. DEG. C(DEG. F)        43.3 (110.0)       43.3 (110.0)       43.3 (110.0)       43.3 (110.0)
  BLOWER REVOLUTIONS                          40639              69654              40525              69585
  CVS FLOW STD. CU. METRES(SCF)           76.2 (2689.8)     130.2 (4599.0)      75.8 (2675.8)     130.3 (4603.2)
  HC   SAMPLE METER/RANGE/PPM             26.0/ 3/  260      18.6/ 3/  186      37.8/ 2/   38      11.4/ 2/   11
  HC   BCKGRD METER/RANGE/PPM              1.3/ 3/   13       1.3/ 3/   13      11.0/ 2/   11      10.1/ 2/   10
  CO   SAMPLE METER/RANGE/PPM             59.4/ 2/ 3850      52.5/ 2/ 3394      76.8/12/  172       9.8/13/    9
  CO   BCKGRD METER/RANGE/PPM               .1/ 2/    6        .3/ 2/   18       4.5/12/    8       6.6/13/    6
  CO2  SAMPLE METER/RANGE/PCT             78.3/ 3/ 1.43      52.4/ 3/  .91      79.4/ 3/ 1.45      56.4/ 3/  .98
  CO2  BCKGRD METER/RANGE/PCT              3.6/ 3/  .06       3.6/ 3/  .06       3.6/ 3/  .06       3.8/ 3/  .06
  NOX  SAMPLE METER/RANGE/PPM             40.7/ 2/   41       9.4/ 2/    9      74.1/ 3/  222      42.0/ 3/  126
  NOX  BCKGRD METER/RANGE/PPM              1.3/ 2/    1       1.0/ 2/    1        .4/ 3/    1        .6/ 3/    2
  DILUTION FACTOR                             7.36               10.68               9.12              13.58

  HC   CONCENTRATION PPM                       249                174                 28                  2
  CO   CONCENTRATION PPM                      3680               3266                158                  3
  CO2  CONCENTRATION PCT                      1.38                .86               1.40                .93
  NOX  CONCENTRATION PPM                      39.6                8.5              221.2              124.3
  HC   MASS GRAMS                            10.93              13.08               1.22                .15
  CO   MASS GRAMS                           326.35             495.28              13.91                .40
  CO2  MASS GRAMS                           1921.3             2046.8             1991.7             2221.6
  NOX  MASS GRAMS                             5.75               2.11              31.98              30.92

  HC   GRAMS/KM                               1.87               2.09                .21                .02
  CO   GRAMS/KM                              55.77              79.14               2.39                .08
  CO2  GRAMS/KM                              328.3              327.0              333.9              356.5
  NOX  GRAMS/KM                                .98                .34               5.50               4.96
  FUEL CONSUMPTION BY CB L/100KM             18.01              19.55              14.44              15.23

  RUN TIME              SECONDS                505                868                505                867
  AVG. EXH. OXYGEN      PERCENT                .55                .35                 --               1.69
  CATALYST AVG. TEMP.   DEG. C                 366                461                449                481
  CATALYST MAX. TEMP.   DEG. C                 538                512                553                525
  MEASURED DISTANCE     KM                    5.85               6.26               5.82               6.23
      DFC, WET (DRY)                                .891 ( .883)                          .913 ( .905)
      SCF, WET (DRY)                               1.000 ( .981)                         1.000 ( .980)
      VOL (SCM)                                            206.4                                 206.1
      KM  (MEASURED)                                       12.11                                 12.05

COMPOSITE RESULTS                                                                                     3-BAG       (4-BAG)
  TEST NUMBER          51C-2        TOTAL FUEL SULFUR    MG/KM   38.20    CARBON DIOXIDE       G/KM       329.2      ( 337.9)
  BAROMETER    MM HG   741.7        AVG. EXH. OXYGEN     PCT       -      FUEL CONSUMPTION     L/100KM    17.83      ( 16.55)
  HUMIDITY     G/KG     10.6        CATALYST AVG. TEMP.  DEG C    443     HYDROCARBONS (THC)   G/KM        1.53      (   .92)
  TEMPERATURE  DEG C    26.7        CATALYST MAX. TEMP.  DEG C    553     CARBON MONOXIDE      G/KM       53.21      ( 29.86)
                                                                          OXIDES OF NITROGEN   G/KM        1.89      (  3.26)
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TABLE B-14. TEST NO. 51F-1 EMISSIONS RESULTS

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                    PVM - 51F   FTP  VEHICLE EMISSIONS RESULTS - DISABLED EGR SENSOR
                                        PROJECT 11-5402-001

TEST NO.   51F-1     RUN   1                  VEHICLE NO.   51                    TEST WEIGHT    2041 KG(  4500 LBS)
VEHICLE MODEL    79 MERCURY MARQUIS           DATE     2/26/79                    ACTUAL ROAD LOAD    9.9 KW( 12.0 HP)
ENGINE 5.7 L(351 CID) V-8                     BAG CART NO.  1                     GASOLINE  EM-344
TRANSMISSION A3                               DYNO NO.      3                     ODOMETER    1331 KM(   827 MILES)
GVW  2434 KG(  5365 LBS)                      CVS NO.       2

BAROMETER 753.11 MM HG(29.65 IN HG)           DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
RELATIVE HUMIDITY 22 PCT                      ABS. HUMIDITY  4.4 GM/KG            NOX HUMIDITY CORRECTION FACTOR   .83
BAG RESULTS
   BAG NUMBER                                       1                    2                  3                    4
   DESCRIPTION                               COLD TRANSIENT         STABILIZED        HOT TRANSIENT          STABILIZED

   BLOWER DIF P MM. H2O(IN. H2O)              762.0 (30.0)         762.0 (30.0)        762.0 (30.0)         762.0 (30.0)
   BLOWER INLET P MM. H2O(IN. H2O)            736.6 (29.0)         736.6 (29.0)        736.6 (29.0)         736.6 (29.0)
   BLOWER INLET TEMP. DEG. C(DEG. F)           45.6 (114.0)         43.3 (110.0)        43.3 (110.0)         43.3 (110.0)
   BLOWER REVOLUTIONS                            40633                69722               40619                69640
   CVS FLOW STD. CU. METRES(SCF)              77.7 (2743.2)        133.3 (4707.8)      77.7 (2742.8)        133.1 (4702.0)
   HC   SAMPLE METER/RANGE/PPM               55.2/ 2/   55         18.4/ 2/   18       22.0/ 2/   22         14.7/ 2/   15
   HC   BCKGRD METER/RANGE/PPM               13.5/ 2/   13         13.3/ 2/   13        8.9/ 2/    9          8.9/ 2/    9
   CO   SAMPLE METER/RANGE/PPM               62.3/11/  253         13.3/13/   13       29.3/13/   28         10.2/13/   10
   CO   BCKGRD METER/RANGE/PPM                1.4/11/    4          3.9/13/    4        1.8/13/    2          2.0/13/    2
   CO2  SAMPLE METER/RANGE/PCT               92.3/ 3/ 1.73         62.5/ 3/ 1.11       82.6/ 3/ 1.52        61.7/ 3/ 1.10
   CO2  BCKGRD METER/RANGE/PCT                4.1/ 3/  .06          3.8/ 3/  .06        3.2/ 3/  .05         3.9/ 3/  .06
   NOX  SAMPLE METER/RANGE/PPM               43.1/ 3/  129         31.6/ 3/   95       42.9/ 3/  129         31.5/ 3/   94
   NOX  BCKGRD METER/RANGE/PPM                 .8/ 3/    2           .6/ 3/    2         .4/ 3/    1           .5/ 3/    2
   DILUTION FACTOR                                7.63                12.01               8.77                 12.19

   HC   CONCENTRATION PPM                          43                    6                  14                    7
   CO   CONCENTRATION PPM                         239                    9                  25                    8
   CO2  CONCENTRATION PCT                        1.67                 1.06                1.48                 1.04
   NOX  CONCENTRATION PPM                       127.7                 93.1               127.6                 93.1
   HC   MASS GRAMS                               1.95                  .48                 .63                  .50
   CO   MASS GRAMS                              21.62                 1.39                2.28                 1.21
   CO2  MASS GRAMS                             2377.9               2585.9              2105.2               2540.1
   NOX  MASS GRAMS                              15.72                19.67               15.71                19.64

   HC   GRAMS/KM                                  .33                  .08                 .11                  .08
   CO   GRAMS/KM                                 3.63                  .22                 .39                  .19
   CO2  GRAMS/KM                                398.8                411.9               356.8                404.5
   NOX  GRAMS/KM                                 2.64                 3.13                2.66                 3.13
   FUEL CONSUMPTION BY CB L/100KM               17.31                17.61               15.27                17.29

   RUN TIME              SECONDS                  505                  868                 505                  868
   AVG. EXH. OXYGEN      PERCENT                 4.00                 4.44                4.30                 4.37
   CATALYST AVG. TEMP.   DEG. C                   473                  518                 476                  518
   CATALYST MAX. TEMP.   DEG. C                   639                  606                 580                  601
   MEASURED DISTANCE     KM                      5.96                 6.28                5.90                 6.28
         DFC, WET (DRY)                                  .899 ( .899)                               .906 ( .906)
         SCF, WET (DRY)                                 1.000 ( .987)                              1.000 ( .988)
         VOL (SCM)                                              211.0                                      210.8
         KM  (MEASURED)                                         12.24                                      12.18

COMPOSITE RESULTS                                                                                       3-BAG          (4-BAG)
   TEST NUMBER           51F-1         TOTAL FUEL SULFUR    MG/KM    36.22       CARBON DIOXIDE       G/KM       394.0         ( 391.8)
   BAROMETER     MM HG   753.1         AVG. EXH. OXYGEN     PCT       4.34       FUEL CONSUMPTION     L/100KM    16.90         ( 16.81)
   HUMIDITY      G/KG      4.4         CATALYST AVG. TEMP.  DEG C      502       HYDROCARBONS (THC)   G/KM         .14         (   .14)
   TEMPERATURE   DEG C    25.6         CATALYST MAX. TEMP.  DEG C      639       CARBON MONOXIDE      G/KM         .98         (   .97)
                                                                                 OXIDES OF NITROGEN   G/KM        2.90         (  2.90)
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TABLE B-15. TEST NO. 51M-1 EMISSIONS RESULTS

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                         PVM - 51M   FTP  VEHICLE EMISSIONS RESULTS - 12 PCT. MISFIRE
                                          PROJECT 11-5402-001

TEST NO.   51M-1    RUN  1                  VEHICLE NO.   51                      TEST WEIGHT   2041 KG(  4500 LBS)
VEHICLE MODEL   79 MERCURY MARQUIS          DATE     2/27/79                      ACTUAL ROAD LOAD   8.9 KW( 12.0 HP)
ENGINE 5.7 L(351 CID) V-8                   BAG CART NO.  1                       GASOLINE  EM-344
TRANSMISSION A3                             DYNO NO.      3                       ODOMETER   1366 KM(   849 MILES)
GVW  2434 KG(  5365 LBS)                    CVS NO.       2

BAROMETER 738.89 MM HG(29.09 IN HG)         DRY BULB TEMP. 24.4 DEG C(76.0 DEG F)
RELATIVE HUMIDITY 38 PCT                    ABS. HUMIDITY  7.5 GM/KG              NOX HUMIDITY CORRECTION FACTOR   .91
BAG RESULTS
   BAG NUMBER                                      1                   2                   3                   4
   DESCRIPTION                              COLD TRANSIENT        STABILIZED        HOT TRANSIENT         STABILIZED

   BLOWER DIF P MM. H2O(IN. H2O)            762.0 (30.0)        762.0 (30.0)        762.0 (30.0)        762.0 (30.0)
   BLOWER INLET P MM. H2O(IN. H2O)          736.6 (29.0)        736.6 (29.0)        736.6 (29.0)        736.6 (29.0)
   BLOWER INLET TEMP. DEG. C(DEG. F)         43.9 (111.0)        43.3 (110.0)        43.3 (110.0)        43.3 (110.0)
   BLOWER REVOLUTIONS                          40749               69816               40661               69795
   CVS FLOW STD. CU. METRES(SCF)             76.2 (2692.3)      130.7 (4616.6)       76.1 (2688.8)      130.7 (4615.2)
   HC  SAMPLE METER/RANGE/PPM              28.9/ 3/  289       20.6/ 2/   21       46.0/ 2/   46       17.8/ 2/   18
   HC  BCKGRD METER/RANGE/PPM               2.4/ 3/   24       19.7/ 2/   20       16.2/ 2/   16       15.7/ 2/   16
   CO  SAMPLE METER/RANGE/PPM              54.3/12/  120       18.5/13/   18       51.2/13/   49       15.4/13/   15
   CO  BCKGRD METER/RANGE/PPM               5.8/12/   10        9.5/13/    9        4.8/13/    5        4.0/13/    4
   CO2 SAMPLE METER/RANGE/PCT              94.6/ 3/ 1.77       64.1/ 3/ 1.14       86.9/ 3/ 1.61       63.3/ 3/ 1.13
   CO2 BCKGRD METER/RANGE/PCT               4.0/ 3/  .06        3.5/ 3/  .05        3.5/ 3/  .05        4.3/ 3/  .07
   NOX SAMPLE METER/RANGE/PPM              80.9/ 2/   81       14.8/ 2/   15       23.9/ 2/   24       12.1/ 2/   12
   NOX BCKGRD METER/RANGE/PPM               1.7/ 2/    2        1.9/ 2/    2        1.7/ 2/    2        1.7/ 2/    2
   DILUTION FACTOR                             7.38                11.67                8.26               11.84

   HC  CONCENTRATION PPM                       268                  3                   32                  3
   CO  CONCENTRATION PPM                       106                  9                   43                 11
   CO2 CONCENTRATION PCT                      1.72                1.10                1.57                1.07
   NOX CONCENTRATION PPM                      79.4                13.1                22.4                10.5
   HC  MASS GRAMS                            11.79                 .20                1.39                 .26
   CO  MASS GRAMS                             9.40                1.33                3.78                1.63
   CO2 MASS GRAMS                           2403.5              2623.1              2183.5              2556.5
   NOX MASS GRAMS                            10.48                2.96                2.95                2.39

   HC  GRAMS/KM                               2.01                 .03                 .24                 .04
   CO  GRAMS/KM                               1.60                 .21                 .65                 .26
   CO2 GRAMS/KM                              409.2               419.7               372.8               408.3
   NOX GRAMS/KM                               1.79                 .47                 .50                 .38
   FUEL CONSUMPTION BY CB L/100KM            17.85               17.93               15.98               17.45

   RUN TIME               SECONDS              505                 868                 505                 868
   AVG. EXH. OXYGEN       PERCENT             4.79                4.02                3.72                3.80
   CATALYST AVG. TEMP.    DEG. C                -                  678                 641                 684
   CATALYST MAX. TEMP.    DEG. C               769                 713                 769                 721
   MEASURED DISTANCE      KM                  5.87                6.25                5.86                6.26
         DFC, WET (DRY)                               .896 ( .891)                        .902 ( .897)
         SCF, WET (DRY)                              1.000 ( .981)                       1.000 ( .982)
         VOL (SCM)                                          206.9                               206.8
         KM  (MEASURED)                                     12.12                               12.12

COMPOSITE RESULTS                                                                                     3-BAG        (4-BAG)
   TEST NUMBER          51M-1        TOTAL FUEL SULFUR   MG/KM    37.24      CARBON DIOXIDE       G/KM      404.6       ( 401.2)
   BAROMETER    MM HG   738.9        AVG. EXH. OXYGEN    PCT       4.08      FUEL CONSUMPTION     L/100KM   17.38       ( 17.24)
   HUMIDITY     G/KG      7.5        CATALYST AVG. TEMP. DEG C       -       HYDROCARBONS (THC)   G/KM        .50       (   .50)
   TEMPERATURE  DEG C    24.4        CATALYST MAX. TEMP. DEG C      769      CARBON MONOXIDE      G/KM        .62       (   .64)
                                                                             OXIDES OF NITROGEN   G/KM        .75       (   .73)
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TABLE B-16. TEST NO. 513H-1 EMISSIONS RESULTS

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                              PVM - 51B   FTP  VEHICLE EMISSIONS RESULTS - DIS. 0 SEN. + NO AIR
                                                  PROJECT 11-5402-001

TEST NO.   51BH-1   RUN   1                       VEHICLE NO.   51                 TEST WEIGHT   2041 KG(  4500 LBS)
VEHICLE MODEL   79 MERCURY MARQUIS                DATE    3/ 5/79                  ACTUAL ROAD LOAD   8.9 KW( 12.0 HP)
ENGINE 5.7 L(351 CID) V-8                         BAG CART NO.  1                  GASOLINE  EM-344
TRANSMISSION A3                                   DYNO NO.      3                  ODOMETER       0 KM(     -0 MILES)
GVW  2434 KG(  5365 LBS)                          CVS NO.       2

BAROMETER 749.05 MM HG(29.49 IN HG)               DRY BULB TEMP. 23.9 DEG C(75.0 DEG F)
RELATIVE HUMIDITY 25 PCT                          ABS. HUMIDITY  4.6 GM/KG         NOX HUMIDITY CORRECTION FACTOR   .83
BAG RESULTS
   BAG NUMBER                                         1                 2                 3                 4
   DESCRIPTION                                  COLD TRANSIENT      STABILIZED       HOT TRANSIENT       STABILIZED

   BLOWER DIF P MM. H2O(IN. H2O)                 762.0 (30.0)      762.0 (30.0)      762.0 (30.0)      762.0 (30.0)
   BLOWER INLET P MM. H2O(IN. H2O)               736.6 (29.0)      736.6 (29.0)      736.6 (29.0)      736.6 (29.0)
   BLOWER INLET TEMP. DEG. C(DEG. F)              42.8 (109.0)      42.2 (108.0)      43.3 (110.0)      43.3 (110.0)
   BLOWER REVOLUTIONS                               40650             69755             40600             69586
   CVS FLOW STD. CU. METRES(SCF)                 77.3 (2731.5)    132.8 (4691.3)     77.2 (2725.1)    132.2 (4670.5)
   HC  SAMPLE METER/RANGE/PPM                  13.3/ 3/  133     56.5/ 2/   56     25.0/ 2/   25     11.2/ 2/   11
   HC  BCKGRD METER/RANGE/PPM                   1.1/ 3/   11      9.9/ 2/   10     11.7/ 2/   12     11.1/ 2/   11
   CO  SAMPLE METER/RANGE/PPM                  37.0/ 3/  877     86.8/11/  418     50.6/12/  112      5.9/13/    6
   CO  BCKGRD METER/RANGE/PPM                    .6/ 3/   14      3.2/11/   10      3.3/12/    6      4.9/13/    5
   CO2 SAMPLE METER/RANGE/PCT                  83.0/ 3/ 1.53     57.3/ 3/ 1.01     80.2/ 3/ 1.47     58.2/ 3/ 1.03
   CO2 BCKGRD METER/RANGE/PCT                   4.4/ 3/  .07      4.6/ 3/  .07      4.7/ 3/  .07      4.3/ 3/  .07
   NOX SAMPLE METER/RANGE/PPM                  34.4/ 3/  103     33.2/ 2/   33     63.2/ 3/  190     93.3/ 2/   93
   NOX BCKGRD METER/RANGE/PPM                    .7/ 3/    2      2.8/ 2/    3       .8/ 3/    2      2.0/ 2/    2
   DILUTION FACTOR                                  8.22             12.69              9.01             13.02

   HC  CONCENTRATION PPM                            123                47                15                 1
   CO  CONCENTRATION PPM                            832               398               102                 1
   CO2 CONCENTRATION PCT                           1.47               .94              1.41               .97
   NOX CONCENTRATION PPM                          101.4              30.6             187.5              91.5
   HC  MASS GRAMS                                  5.50              3.63               .65               .07
   CO  MASS GRAMS                                 74.96             61.55              9.21               .19
   CO2 MASS GRAMS                                2085.6            2297.1            1991.7            2340.0
   NOX MASS GRAMS                                 12.48              6.48             23.03             19.26

   HC  GRAMS/KM                                     .93               .58               .11               .01
   CO  GRAMS/KM                                   12.74              9.81              1.56               .03
   CO2 GRAMS/KM                                   354.4             366.0             337.1             374.2
   NOX GRAMS/KM                                    2.12              1.03              3.90              3.08
   FUEL CONSUMPTION BY CB L/100KM                 16.11             16.36             14.51             15.97

   RUN TIME               SECONDS                   505               868               505               867
   AVG. EXH. OXYGEN       PERCENT                   .50               .58              1.55              1.95
   CATALYST AVG. TEMP.    DEG. C                    383               508               476               501
   CATALYST MAX. TEMP.    DEG. C                    563               546               584               554
   MEASURED DISTANCE      KM                       5.89              6.28              5.91              6.25
        DFC, WET (DRY)                                    .905 ( .904)                        .911 ( .909)
        SCF, WET (DRY)                                   1.000 ( .987)                       1.000 ( .987)
        VOL (SCM)                                                210.2                               209.4
        KM  (MEASURED)                                           12.16                               12.16

COMPOSITE RESULTS                                                                                   3-BAG       (4-BAG)
   TEST NUMBER          518H-1        TOTAL FUEL SULFUR   MG/KM   33.85     CARBON DIOXIDE       G/KM      355.6      ( 358.0)
   BAROMETER    MM HG   749.0         AVG. EXH. OXYGEN    PCT       .77     FUEL CONSUMPTION     L/100KM    15.79     ( 15.68)
   HUMIDITY     G/KG      4.6         CATALYST AVG. TEMP. DEG C     481     HYDROCARBONS (THC)   G/KM        .52      (   .36)
   TEMPERATURE  DEG C    23.9         CATALYST MAX. TEMP. DEG C     584     CARBON MONOXIDE      G/KM       8.14      (  5.27)
                                                                            OXIDES OF NITROGEN   G/KM       2.05      (  2.65)
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TABLE B-17. TEST NO. 51CH-1 EMISSIONS RESULTS

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                                        PVM - 51C   FTP  VEHICLE EMISSIONS RESULTS - DIS. CYS + NO AIR
                                                    PROJECT 11-5402-001

TEST NO.   51CH-1   RUN   1                  VEHICLE NO.   51                      TEST WEIGHT   2041 KG(  4500 LBS)
VEHICLE MODEL   79 MERCURY MARQUIS           DATE    3/ 2/79                       ACTUAL ROAD LOAD   8.9 KW( 12.0 HP)
ENGINE 5.7 L(351 CID) V-8                    BAG CART NO.  1                       GASOLINE  EM-344
TRANSMISSION A3                              DYNO NO.      3                       ODOMETER   1476 KM(   917 MILES)
GVW  2434 KG(  5365 LBS)                     CVS NO.       2

BAROMETER 738.99 MM HG(29.09 IN HG)          DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
RELATIVE HUMIDITY 60 PCT                     ABS. HUMIDITY 12.7 GM/KG              NOX HUMIDITY CORRECTION FACTOR  1.07
BAG RESULTS
   BAG NUMBER                                      1                  2                   3                    4
   DESCRIPTION                               COLD TRANSIENT       STABILIZED        HOT TRANSIENT          STABILIZED

   BLOWER DIF P MM. H2O(IN. H2O)              762.0 (30.0)       762.0 (30.0)        762.0 (30.0)        762.0 (30.0)
   BLOWER INLET P MM. H2O(IN. H2O)            736.6 (29.0)       736.6 (29.C)        736.6 (29.0)        736.6 (29.0)
   BLOWER INLET TEMP. DEG. C(DEG. F)           43.3 (110.0)       43.3 (110.0)        43.3 (110.0)        43.3 (110.0)
   BLOWER REVOLUTIONS                             40641              69731               40601               69772
   CVS FLOW STD. CU. METRES(SCF)               76.1 (2687.7)     130.5 (4610.9)       76.0 (2684.8)      130.6 (4613.5)
   HC  SAMPLE METER/RANGE/PPM                 86.0/ 3/  860      39.9/ 3/  399       31.7/ 2/   32       15.2/ 2/   15
   HC  BCKGRD METER/RANGE/PPM                  1.7/ 3/   17       2.2/ 3/   22       18.4/ 2/   18       19.8/ 2/   20
   CO  SAMPLE METER/RANGE/PPM                 96.5/ 1/15574      62.7/ 1/ 6053       59.1/12/  132       27.0/13/   26
   CO  BCKGRD METER/RANGE/PPM                   .4/ 1/   22        .9/ 1/   51       16.3/12/   32       25.6/13/   24
   CO2 SAMPLE METER/RANGE/PCT                 60.1/ 3/ 1.06      46.4/ 3/  .80       77.2/ 3/ 1.41       56.6/ 3/ 1.00
   CO2 BCKGRD METER/RANGE/PCT                  3.2/ 3/  .05       3.8/ 3/  .06        3.9/ 3/  .06        4.3/ 3/  .07
   NOX SAMPLE METER/RANGE/PPM                  8.5/ 2/    9      14.1/ 2/   14       70.1/ 3/  210       37.2/ 3/  112
   NOX BCKGRD METER/RANGE/PPM                  1.0/ 2/    1        .7/ 2/    1         .5/ 3/    2         .7/ 3/    2
   DILUTION FACTOR                                 5.06               9.42                9.39               13.40

   HC  CONCENTRATION PPM                           846                379                  15                  -3
   CO  CONCENTRATION PPM                         14935               5798                  98                   3
   CO2 CONCENTRATION PCT                          1.03                .75                1.36                 .93
   NOX CONCENTRATION PPM                           7.7               13.5               209.0               109.7
   HC  MASS GRAMS                                37.15              28.56                 .67                -.24
   CO  MASS GRAMS                              1323.41             881.46                8.66                 .39
   CO2 MASS GRAMS                               1429.2             1783.6              1890.9              2235.6
   NOX MASS GRAMS                                 1.20               3.60               32.48               29.29

   HC  GRAMS/KM                                   6.47               4.65                 .12                -.04
   CO  GRAMS/KM                                 230.44             143.48                1.52                 .06
   CO2 GRAMS/KM                                  248.9              290.3               331.1               366.0
   NOX GRAMS/KM                                    .21                .59                5.69                4.80
   FUEL CONSUMPTION BY CB L/100KM                26.95              22.64               14.25               15.62

   RUN TIME                SECONDS                 504                867                 505                 868
   AVG. EXH. OXYGEN        PERCENT                 .36                .54                  -                   -
   CATALYST AVG. TEMP.     DEG. C                   -                 438                  -                   -
   CATALYST MAX. TEMP.     DEG. C                  478                466                 550                 542
   MEASURED DISTANCE       KM                     5.74               6.14                5.71                6.11
        DFC, WET (DRY)                                   .860 ( .849)                           .914 ( .902)
        SCF, WET (DRY)                                  1.000 ( .979)                          1.000 ( .976)
        VOL (SCM)                                               206.6                                  206.6
        KM  (MEASURED)                                          11.89                                  11.82

COMPOSITE RESULTS                                                                                    3-BAG         (4-BAG)
   TEST NUMBER           51CH-1      TOTAL FUEL SULFUR    MG/KM   45.51    CARBON DIOXIDE       G/KM       292.9       ( 315.2)
   BAROMETER     MM HG   738.9       AVG. EXH. OXYGEN     PCT        -     FUEL CONSUMPTION     L/100KM     21.23       ( 19.16)
   HUMIDITY      G/KG     12.7       CATALYST AVG. TEMP.  DEG C      -     HYDROCARBONS (THC)   G/KM         3.78       (  2.40)
   TEMPERATURE   DEG C    25.6       CATALYST MAX. TEMP.  DEG C     550    CARBON MONOXIDE      G/KM       122.56       ( 80.20)
                                                                           OXIDES OF NITROGEN   G/KM         1.91       (  3.15)
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TABLE B-18. TEST NO. 51CH-2 EMISSIONS RESULTS

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                    PVM - 51C   FTP  VEHICLE EMISSIONS RESULTS - DIS. CTS + NO AIR
                                     PROJECT 11-5902-001

TEST NO.   51CH-2   RUN   1               VEHICLE NO.   51              TEST WEIGHT   2041 KG( 4500 LBS)
VEHICLE MODEL   79 MERCURY MARQUIS        DATE    3/23/79               ACTUAL ROAD LOAD   8.9 KW( 12.0 HP)
ENGINE 5.7 L(351 CID) V-8                 BAG CART NO.  1               GASOLINE  EM-344
TRANSMISSION A3                           DYNO NO.      3               ODOMETER   1699 KM(  1056 MILES)
GVW  2434 KG(  5365 LBS)                  CVS NO.       2

BAROMETER 739.90 MM HG(29.13 IN HG)       DRY BULB TEMP. 23.9 DEG C(75.0 DEG F)
RELATIVE HUMIDITY 34 PCT                  ABS. HUMIDITY  6.5 GM/KG             NOX HUMIDITY CORRECTION FACTOR   .88
BAG RESULTS
  BAG NUMBER                                    1                  2                  3                  4
  DESCRIPTION                             COLD TRANSIENT      STABILIZED       HOT TRANSIENT       STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)           787.4 (31.0)       787.4 (31.0)       787.4 (31.0)       787.4 (31.0)
  BLOWER INLET P MM. H2O(IN. H2O)         774.7 (30.5)       774.7 (30.5)       774.7 (30.5)       774.7 (30.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)        43.9 (111.0)       43.3 (110.0)       44.4 (112.0)       43.9 (111.0)
  BLOWER REVOLUTIONS                          40561              69665              40626              69700
  CVS FLOW STD. CU. METRES(SCF)            75.6 (2670.1)     130.0 (4590.0)      75.6 (2671.6)     129.9 (4588.2)
  HC   SAMPLE METER/RANGE/PPM             23.9/ 3/  239      18.9/ 3/  184      22.5/ 2/   23       7.8/ 2/    8
  HC   BCKGRD METER/RANGE/PPM               .6/ 3/    6        .8/ 3/    8       6.1/ 2/    6       5.6/ 2/    6
  CO   SAMPLE METER/RANGE/PPM             58.1/ 2/ 2919      54.2/ 2/ 2660      94.6/13/   96      12.9/13/   12
  CO   BCKGRD METER/RANGE/PPM               .1/ 2/    4        .3/ 2/   11       6.2/13/    6       4.3/13/    4
  CO2  SAMPLE METER/RANGE/PCT             75.1/ 3/ 1.37      50.9/ 3/  .88      76.4/ 3/ 1.40      55.5/ 3/  .97
  CO2  BCKGRD METER/RANGE/PCT              3.3/ 3/  .05       3.6/ 3/  .06       3.3/ 3/  .05       3.4/ 3/  .05
  NOX  SAMPLE METER/RANGE/PPM             36.9/ 2/   37      10.9/ 2/   11      85.4/ 3/  256      43.5/ 3/  130
  NOX  BCKGRD METER/RANGE/PPM               .7/ 2/    1        .9/ 2/    1        .6/ 3/    2        .8/ 3/    2
  DILUTION FACTOR                              8.01              11.53               9.53              13.73

  HC   CONCENTRATION PPM                        234                182                 17                  3
  CO   CONCENTRATION PPM                       2806               2575                 87                  8
  CO2  CONCENTRATION PCT                       1.32                .83               1.35                .93
  NOX  CONCENTRATION PPM                       36.3               10.1              254.6              128.3
  HC   MASS GRAMS                             10.19              13.62                .74                .20
  CO   MASS GRAMS                            247.04             389.65               7.68               1.24
  CO2  MASS GRAMS                            1833.4             1985.1             1870.2             2202.5
  NOX  MASS GRAMS                              4.61               2.20              32.35              27.99

  HC   GRAMS/KM                                1.76               2.20                .13                .03
  CO   GRAMS/KM                               42.78              62.89               1.34                .20
  CO2  GRAMS/KM                               317.5              320.4              326.7              357.9
  NOX  GRAMS/KM                                 .80                .36               5.65               4.55
  FUEL CONSUMPTION BY CB L/100KM              16.66              18.19              14.05              15.29

  RUN TIME               SECONDS                504                868                506                867
  AVG. EXH. OXYGEN       PERCENT                .69                .49               1.54               1.45
  CATALYST AVG. TEMP.    DEG. C                 365                467                441                481
  CATALYST MAX. TEMP.    DEG. C                 542                588                546                508
  MEASURED DISTANCE      KM                    5.78               6.20               5.72               6.15
      DFC, WET (DRY)                                   .899 ( .895)                          .915 ( .911)
      SCF, WET (DRY)                                  1.000 ( .986)                         1.000 ( .985)
      VOL (SCM)                                              205.6                                 205.5
      KM  (MEASURED)                                         11.97                                 11.88

COMPOSITE RESULTS
  TEST NUMBER             51CH-2                                                                 3-BAG       (4-BAG)
  BAROMETER      MM HG    739.9     TOTAL FUEL SULFUR    MG/KM   35.88   CARBON DIOXIDE      G/KM      321.5      ( 332.6)
  HUMIDITY       G/KG       6.5     AVG. EXH. OXYGEN     PCT       .74   FUEL CONSUMPTION    L/100KM   16.74      ( 15.88)
  TEMPERATURE    DEG C     23.9     CATALYST AVG. TEMP.  DEG C     445   HYDROCARBONS (THC)  G/KM       1.54      (   .90)
                                    CATALYST MAX. TEMP.  DEG C     588   CARBON MONOXIDE     G/KM      41.87      ( 23.30)
                                                                         OXIDES OF NITROGEN  G/KM       1.90      (  3.14)
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TABLE B-19. TEST NO. 51KH-1 EMISSIONS RESULTS

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                     PVM - 51K   FTP  VEHICLE EMISSIONS RESULTS - DIS. FCA + NO AIR
                                        PROJECT 11-5402-001

TEST NO.   51KH-1   RUN   1                VEHICLE NO.   51                  TEST WEIGHT   2041 KG( 4500 LBS)
VEHICLE MODEL   79 MERCURY MARQUIS         DATE    2/28/79                   ACTUAL ROAD LOAD   8.9 KW( 12.0 HP)
ENGINE 5.7 L(351 CID) V-8                  BAG CART NO.  1                   GASOLINE  EM-344
TRANSMISSION A3                            DYNO NO.      3                   ODOMETER   1403 KM(   872 MILES)
GVW  2434 KG(  5365 LBS)                   CVS NO.       2

BAROMETER 743.46 MM HG(29.27 IN HG)        DRY BULB TEMP. 25.0 DEG C(77.0 DEG F)
RELATIVE HUMIDITY 24 PCT                   ABS. HUMIDITY  4.8 GM/KG          NOX HUMIDITY CORRECTION FACTOR   .84
BAG RESULTS
  BAG NUMBER                                     1                  2                   3                   4
  DESCRIPTION                              COLD TRANSIENT      STABILIZED        HOT TRANSIENT        STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)            762.0 (30.0)       762.0 (30.0)       762.0 (30.0)        762.0 (30.0)
  BLOWER INLET P MM. H2O(IN. H2O)          736.6 (29.0)       736.6 (29.0)       736.6 (29.0)        736.6 (29.0)
  BLOWER INLET TEMP. DEG. C(DEG. F)         43.3 (110.0)       41.1 (106.0)       43.3 (110.0)        43.3 (110.0)
  BLOWER REVOLUTIONS                           40471              69750              40610               69639
  CVS FLOW STD. CU. METRES(SCF)            76.3 (2694.6)     132.0 (4662.1)      76.5 (2703.6)      131.3 (4636.0)
  HC   SAMPLE METER/RANGE/PPM              33.5/ 3/  335      21.2/ 3/  212      26.4/ 3/  264       20.8/ 3/  208
  HC   BCKGRD METER/RANGE/PPM               1.7/ 3/   17       1.5/ 3/   15       1.3/ 3/   13        1.4/ 3/   14
  CO   SAMPLE METER/RANGE/PPM              78.1/ 2/ 4451      62.7/ 2/ 3240      74.4/ 2/ 4140       66.8/ 2/ 3542
  CO   BCKGRD METER/RANGE/PPM                .1/ 2/    4        .2/ 2/    8        .3/ 2/   11         .3/ 2/   11
  CO2  SAMPLE METER/RANGE/PCT              73.9/ 3/ 1.34      49.2/ 3/  .85      67.4/ 3/ 1.21       48.3/ 3/  .83
  CO2  BCKGRD METER/RANGE/PCT               3.2/ 3/  .05       3.5/ 3/  .05       3.1/ 3/  .05        3.3/ 3/  .05
  NOX  SAMPLE METER/RANGE/PPM              28.0/ 2/   28       7.9/ 2/    8      24.1/ 2/   24        9.2/ 2/    9
  NOX  BCKGRD METER/RANGE/PPM               2.0/ 2/    2       1.5/ 2/    2       1.2/ 2/    1        1.2/ 2/    1
  DILUTION FACTOR                              7.41               11.27              8.18                11.16

  HC   CONCENTRATION PPM                       320                198                253                 195
  CO   CONCENTRATION PPM                      4298               3155               4002                3447
  CO2  CONCENTRATION PCT                      1.30                .80               1.17                 .79
  NOX  CONCENTRATION PPM                      26.3                6.5               23.0                 8.1
  HC   MASS GRAMS                            14.09              15.10              11.15               14.78
  CO   MASS GRAMS                           381.85             485.00             356.71              526.90
  CO2  MASS GRAMS                           1818.4             1940.7             1639.8              1895.2
  NOx  MASS GRAMS                             3.21               1.38               2.82                1.70

  HC   GRAMS/KM                               2.44               2.46               1.94                2.40
  CO   GRAMS/KM                              66.10              78.91              61.99               85.63
  CO2  GRAMS/KM                              314.8              315.8              285.0               308.0
  NOX  GRAMS/KM                                .56                .22                .49                 .28
  FUEL CONSUMPTION BY CB L/100KM             18.20              19.10              16.58               19.22

  RUN TIME              SECONDS                502                868                505                 867
  AVG. EXH. OXYGEN      PERCENT                .67               0.00                .77                1.05
  CATALYST AVG. TEMP.   DEG. C                 352                 -                 433                 455
  CATALYST MAX. TEMP.   DEG. C                 508                499                538                 508
  MEASURED DISTANCE     KM                    5.78               6.15               5.75                6.15
       DFC, WET (DRY)                              .894 ( .893)                           .898 ( .897)
       SCF, WET (DRY)                             1.000 ( .989)                          1.000 ( .990)
       VOL (SCM)                                        208.3                                  207.8
       KM  (MEASURED)                                   11.92                                  11.91

COMPOSITE RESULTS                                                                                        3-BAG     (4-BAG)
  TEST NUMBER           51KH-1     TOTAL FUEL SULFUR   MG/KM   39.05     CARBON DIOXIDE       G/KM      307.1     ( 304.8)
  BAROMETER     MM HG   743.5      AVG. EXH. OXYGEN    PCT       .27     FUEL CONSUMPTION     L/100KM   18.22     ( 18.25)
  HUMIDITY      G/KG      4.8      CATALYST AVG. TEMP. DEG C      -      HYDROCARBONS (THC)   G/KM       2.31     (  2.29)
  TEMPERATURE   DEG C    25.0      CATALYST MAX. TEMP. DEG C     538     CARBON MONOXIDE      G/KM      71.58     ( 73.56)
                                                                         OXIDES OF NITROGEN   G/KM        .37     (   .38)
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TABLE B-20. TEST NO. 51KH-2 EMISSIONS RESULTS

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                        PVM - 51K   FTP  VEHICLE EMISSIONS RESULTS - DIS. FCA + NO AIR
                                           PROJECT 11-5402-001

TEST NO.   51KH-2   RUN   1               VEHICLE NO.   51                      TEST WEIGHT   2041 KG(  4500 LBS)
VEHICLE MODEL   79 MERCURY MARQUIS        DATE     3/26/79                      ACTUAL ROAD LOAD   8.9 KW( 12.0 HP)
ENGINE 5.7 L(351 CID) V-8                 BAG CART NO.  1                       GASOLINE  EM-344
TRANSMISSION A3                           DYNO NO.      3                       ODOMETER    1730 KM(  1075 MILES)
GVW  2434 KG(  5365 LBS)                  CVS NO.       2

BAROMETER 740.41 MM HG(29.15 IN HG)       DRY BULB TEMP. 26.7 DEG C(80.0 DEG F)
RELATIVE HUMIDITY 41 PCT                  ABS. HUMIDITY   9.2 GM/KG             NOX HUMIDITY CORRECTION FACTOR   .95
BAG RESULTS
   BAG NUMBER                                   1                   2                   3                   4
   DESCRIPTION                            COLD TRANSIENT       STABILIZED        HOT TRANSIENT         STABILIZED

   BLOWER DIF P MM. H2O(IN. H2O)           787.4 (31.0)        787.4 (31.0)        787.4 (31.0)        787.4 (31.0)
   BLOWER INLET P MM. H2O(IN. H2O)         762.0 (30.0)        762.0 (30.0)        762.0 (30.0)        762.0 (30.0)
   BLOWER INLET TEMP. DEG. C(DEG. F)        44.4 (112.0)        44.4 (112.0)        43.9 (111.0)        43.9 (111.0)
   BLOWER REVOLUTIONS                          40630               69704               40552               69661
   CVS FLOW STD. CU. METRES(SCF)            75.8 (2678.0)      130.1 (4593.8)       75.7 (2675.1)      130.1 (4595.2)
   HC  SAMPLE METER/RANGE/PPM              31.0/ 3/  310       21.3/ 3/  213       27.7/ 3/  277       22.2/ 3/  222
   HC  BCKGRD METER/RANGE/PPM               1.2/ 3/   12        1.5/ 3/   15        1.4/ 3/   14        1.6/ 3/   16
   CO  SAMPLE METER/RANGE/PPM              75.1/ 2/ 4198       63.7/ 2/ 3312       71.3/ 2/ 3840       66.8/ 2/ 3542
   CO  BCKGRD METER/RANGE/PPM                .2/ 2/    8         .5/ 2/   19         .6/ 2/   23         .6/ 2/   23
   CO2 SAMPLE METER/RANGE/PCT              70.7/ 3/ 1.28       47.1/ 3/  .81       69.5/ 3/ 1.25       48.2/ 3/  .83
   CO2 BCKGRD METER/RANGE/PCT               3.6/ 3/  .06        3.7/ 3/  .06        4.1/ 3/  .06        4.0/ 3/  .06
   NOX SAMPLE METER/RANGE/PPM              25.0/ 2/   25        9.5/ 2/   10       26.5/ 2/   26       13.2/ 2/   13
   NOX BCKGRD METER/RANGE/PPM               1.3/ 2/    1        1.1/ 2/    1        1.2/ 2/    1        1.2/ 2/    1
   DILUTION FACTOR                              7.82               11.61                8.09               11.18

   HC  CONCENTRATION PPM                        300                 199                 265                 207
   CO  CONCENTRATION PPM                       4032                3199                3724                3417
   CO2 CONCENTRATION PCT                       1.23                 .76                1.20                 .78
   NOX CONCENTRATION PPM                       23.9                 8.5                25.4                12.1
   HC  MASS GRAMS                             13.10               14.95               11.56               15.57
   CO  MASS GRAMS                            356.00              484.57              328.46              517.72
   CO2 MASS GRAMS                            1708.4              1809.4              1662.8              1850.4
   NOX MASS GRAMS                              3.30                2.02                3.52                2.87

   HC  GRAMS/KM                                2.25                2.40                1.99                2.50
   CO  GRAMS/KM                               61.16               77.90               56.51               83.04
   CO2 GRAMS/KM                               293.5               290.9               286.1               296.8
   NOX GRAMS/KM                                 .57                 .32                 .60                 .46
   FUEL CONSUMPTION BY CB L/100KM             16.93               17.97               16.27               18.57

   RUN TIME              SECONDS                504                 868                 505                 867
   AVG. EXH. OXYGEN      PERCENT                .75                 .45                  -                   -
   CATALYST AVG. TEMP.   DEG. C                 352                 453                  -                   -
   CATALYST MAX. TEMP.   DEG. C                 512                 491                 544                 512
   MEASURED DISTANCE     KM                    5.82                6.22                5.81                6.23
        DFC, WET (DRY)                                 .898 ( .892)                .898 ( .892)
        SCF, WET (DRY)                                1.000 ( .984)               1.000 ( .984)
        VOL (SCM)                                            205.9                       205.8
        KM  (MEASURED)                                       12.04                       12.05

COMPOSITE RESULTS                                                                                  3-BAG      (4-BAG)
   TEST NUMBER          51KH-2      TOTAL FUEL SULFUR    MG/KM    37.04    CARBON DIOXIDE        G/KM      290.1     ( 291.8)
   BAROMETER    MM HG   740.4       AVG. EXH. OXYGEN     PCT        -      FUEL CONSUMPTION      L/100KM    17.28     ( 17.46)
   HUMIDITY     G/KG      9.2       CATALYST AVG. TEMP.  DEG C      -      HYDROCARBONS (THC)    G/KM        2.26     (  2.29)
   TEMPERATURE  DEG C    26.7       CATALYST MAX. TEMP.  DEG C     544     CARBON MONOXIDE       G/KM       68.53     ( 70.05)
                                                                           OXIDES OF NITROGEN    G/KM         .45     (   .49)
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APPENDIX C

SUMMARIES OF VEHICLE TESTING RESULTS

TABLE C-1. CAR 511 - DISABLED O_2 SENSOR
1979 Mercury Marquis - Three-Way Catalyst

	EMISSION RATE, MG/KM (Except as Noted)								
	UNMODIFIED			WITH MALFUNCTION CONDITION					
	FTP	SET	HFET	FTP	SET	HFET	FTP	SET	HFET
Test Number, PVM-ST	511-11	511-12	511-13	511-21	511-22	511-23	511-31	511-32	511-33
Barometer, mm Hg	740.2	739.9	739.9	737.6	738.1	738.9	742.7	742.7	742.7
Humidity, g/kg	11.1	9.7	9.2	10.2	10.2	9.2	10.6	11.4	10.6
Temperature, °C	25.6	27.2	26.7	24.4	24.4	28.3	25.0	26.7	26.7
Total Fuel Sulfur, mg/km	33.02	25.79	22.18	32.59	24.38	20.75	33.79	25.49	21.23
Avg. Exh. Oxygen, %	3.59	3.45	2.96	3.84	3.86	1.31	3.61	3.92	1.38
Catalyst Avg. Temp., °C	--	--	--	--	--	--	562	617	606
Catalyst Max. Temp., °C	--	--	--	--	--	--	661	715	636
Carbon Dioxide, g/km	358.5	281.6	242.4	354.7	266.0	226.7	367.3	278.2	232.0
Fuel Cons., ℓ/100 km	15.41	12.04	10.35	15.21	11.38	9.68	15.77	11.89	9.91
Regulated Emissions									
Hydrocarbons, (THC), g/km	0.12	0.03	0.01	0.09	0.04	0.01	0.12	0.04	0.01
Carbon Monoxide, g/km	1.35	0.20	0.01	0.82	0.24	0.06	1.10	0.22	0.04
Oxides of Nitrogen, g/km	0.85	0.76	0.79	2.42	2.52	1.30	2.60	2.88	1.25
Particulates									
Total Particulates	4.36	13.66	48.45	3.04	2.02	1.08	8.63	6.23	18.77
Sulfate	0.22	8.16	40.82	0.15	0.54	0.22	2.45	3.68	10.15
Sulfate as % of TFS, %	0.22	10.55	61.35	0.15	0.74	0.35	2.42	4.81	15.94
Compound Group Totals									
Aldehydes & Ketones	0.6	0.8	0.2	0.4	0.2	0.2	0.3	0.1	0.0
Individual Hydrocarbons	65.3	22.2	9.6	56.7	24.8	1.6	72.4	29.1	10.9
Organic Sulfides	0.14	0.05	0.01	0.15	0.10	0.02	1.07	0.46	1.6
Organic Amines	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other Compounds									
Ammonia	2.24	1.19	0.76	4.12	2.86	5.78	2.65	--	--
Cyanide & Cyanogen	0.00	--	--	0.13	--	--	--	--	--
DMNA	--	--	--	--	--	--	--	--	--
Hydrogen Sulfide	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.10	0.00
Nickel Carbonyl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nitrous Oxide	21.45	8.38	4.92	10.66	7.47	4.43	10.42	8.46	4.04

TABLE C-1 (Cont'd.) CAR 511 - DISABLED O_2 SENSOR
1979 Mercury Marquis - Three-Way Catalyst

	EMISSION RATE, MG/KM (Except as Noted)								
	UNMODIFIED			WITH MALFUNCTION CONDITION					
	FTP	SET	HFET	FTP	SET	HFET	FTP	SET	HFET
Test Number, PVM-ST	511-11	511-12	511-13	511-21	511-22	511-23	511-31	511-32	511-33
Aldehydes and Ketones									
Formaldehyde	0.29	0.24	0.21	0.00	0.05	0.00	0.00	0.00	0.00
Acetaldehyde	0.34	0.58	0.00	0.00	0.04	0.00	0.24	0.00	0.00
Acetone	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Isobutyraldehyde	0.00	0.00	0.00	0.17	0.00	0.00	0.09	0.00	0.00
Methyl Ethyl Ketone	0.00	0.00	0.00	0.26	0.14	0.24	0.00	0.05	0.00
Crotonaldehyde	--	--	--	--	--	--	--	--	--
Hexanaldehyde	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzaldehyde	--	--	--	--	--	--	--	--	--
Aldehydes and Ketones	0.6	0.8	0.2	0.4	0.2	0.2	0.3	0.1	0.0
Total as % of THC, %	0.5	2.7	2.0	0.4	0.5	2.0	0.3	0.3	0.0
Individual Hydrocarbons									
Methane	41.97	19.90	8.91	41.97	21.48	10.40	53.36	25.93	9.77
Ethylene	3.99	0.42	0.00	3.21	1.08	0.00	4.72	1.08	0.08
Ethane	4.46	1.65	0.67	1.85	0.66	0.77	2.07	1.10	0.85
Acetylene	1.84	0.00	0.00	1.30	0.00	0.00	1.83	0.00	0.00
Propane	0.37	0.01	0.01	0.54	0.03	0.03	0.18	0.00	0.00
Propylene	2.05	0.00	0.00	1.55	0.28	0.00	1.88	0.06	0.00
Benzene	4.06	0.22	0.00	2.20	0.69	0.20	2.64	0.42	0.23
Toluene	6.52	0.00	0.00	4.07	0.53	0.20	5.67	0.53	0.00
Total Individual HC	65.3	22.2	9.6	56.7	24.8	11.6	72.4	29.1	10.9
Total as % of THC, %	54.4	74.0	96.0	63.0	62.0	116.0	60.3	72.8	109.0
Organic Sulfides									
Carbonyl Sulfide	0.09	0.04	0.01	0.04	0.08	0.00	0.30	0.21	0.52
Methyl Sulfide	0.02	0.01	0.00	0.01	0.02	0.02	0.27	0.25	0.50
Ethyl Sulfide	0.02	0.00	0.00	0.07	0.00	0.00	0.32	0.00	0.10
Methyl Disulfide	0.01	0.00	0.00	0.03	0.00	0.00	0.18	0.00	0.48
Organic Amines									
Monomethylamine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Monoethylamine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Trimethylamine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diethylamine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Triethylamine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE C-1 (Cont'd.) CAR 511 - DISABLED O_2 SENSOR
1979 Mercury Marquis - Three-Way Catalyst

		EMISSION RATE, MG/KM (Except at Noted)								
		UNMODIFIED			WITH MALFUNCTION CONDITION					
		FTP	SET	HFET	FTP	SET	HFET	FTP	SET	HFET
Test Number, PVM-ST		511-11	511-12	511-13	511-21	511-22	511-23	511-31	511-32	511-33
Other Elements										
Chromium	Cr									--
Lead	Pb	0.00	0.00	0.00	0.15	0.13	0.00	0.09	0.00	--
Manganese	Mn									--
Arsenic	As									--
Mercury	Hg									--
Bromine	Br									--
Phosphorus	P									--
Silicon	Si	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.00	--
Cadmium	Cd									--
Aluminum	Al	0.00	0.00	0.00	0.02	0.01	0.01	0.01	0.01	--
Sulfur	S	0.09	4.75	9.39	0.03	0.03	0.05	0.02	0.06	--
Sodium	Na									--
Fluorine	F									--
Magnesium	Mg									--
Potassium	K									--
Chlorine	Cl	0.02	0.01	0.02	0.04	0.67	0.41	0.02	0.24	--
Platinum	Pt									--
Zinc	Zn									--
Copper	Cu									--
Nickel	Ni									--
Iron	Fe	0.04	0.06	0.00	0.14	0.11	0.08	0.05	0.09	--
Vanadium	V									--
Titanium	Ti									--
Barium	Ba	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	--
Calcium	Ca	0.01	0.02	0.02	0.01	0.01	0.00	0.01	0.01	--

Note: Most values of 0.00 for Other Elements have been left blank.

TABLE C-2. CAR 512 - TWELVE PERCENT MISFIRE AND AIR TO BYPASS
1979 MERCURY MARQUIS - THREE-WAY CATALYST

	EMISSION RATE, MG/KM (Except as Noted)								
	UNMODIFIED			WITH MALFUNCTION CONDITION					
	FTP	SET	HFET	FTP	SET	HFET	FTP	SET	HFET
Test Number, PVM-ST	512-11	512-12	512-13	512-21	512-22	512-23	512-31	512-32	512-33
Barometer, mm Hg	744.7	744.2	744.7	744.2	744.2	744.2	743.5	743.5	743.5
Humidity, g/kg	8.7	10.6	11.8	11.8	10.8	11.1	11.3	13.4	11.8
Temperature, °C	24.4	26.7	27.2	23.9	24.4	23.9	23.3	25.6	25.6
Total Fuel Sulfur, mg/km	33.37	25.38	22.54	35.54	25.76	23.00	34.84	24.86	22.86
Avg. Exh. Oxygen, %	4.72	3.96	3.39	0.98	0.63	0.29	0.95	0.53	0.30
Catalyst Avg. Temp., °C	491	564	594	622	728	778	610	721	769
Catalyst Max. Temp., °C	572	610	618	726	787	791	730	781	788
Carbon Dioxide, g/km	361.7	276.7	246.3	368.9	276.4	249.7	361.7	265.6	248.0
Fuel Cons., ℓ/100 km	15.57	11.84	10.52	16.58	12.02	10.73	16.26	11.60	10.67
Regulated Emissions									
Hydrocarbons, (THC), g/km	0.14	0.03	0.01	1.82	0.32	0.09	1.63	0.38	0.10
Carbon Monoxide, g/km	1.67	0.43	0.03	8.86	2.67	0.94	8.95	3.18	1.06
Oxides of Nitrogen, g/km	0.92	0.85	0.95	0.61	0.46	0.47	0.59	0.42	0.36
Particulates									
Total Particulates	--	--	--	10.73	4.45	1.76	9.28	3.05	0.02
Sulfate	1.69	13.56	0.00	0.11	0.07	0.07	0.15	0.05	0.06
Sulfate as % of TFS, %	1.69	17.81	0.00	0.10	0.09	0.10	0.14	0.07	0.09
Compound Group Totals									
Aldehydes & Ketones	6.4	4.1	2.3	0.9	0.3	2.3	2.8	0.8	0.2
Individual Hydrocarbons	75.2	26.1	8.6	324.9	93.1	29.2	320.9	94.6	29.5
Organic Sulfides	--	--	--	0.12	0.04	0.04	0.24	0.04	0.07
Organic Amines	0.01	0.01	0.00	0.02	0.02	0.02	0.06	0.00	0.02
Other Compounds									
Ammonia	3.41	--	--	22.16	--	--	39.70	--	--
Cyanide & Cyanogen	0.00	--	--	1.85	--	--	1.29	--	--
DMNA	--	--	---	--	--	--	--	--	--
Hydrogen Sulfide	0.00	0.00	0.00	0.71	0.57	0.11	0.46	0.45	0.14
Nickel Carbonyl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nitrous Oxide	29.65	13.81	5.73	14.09	4.91	2.57	9.77	4.68	2.30

TABLE C-2 (Cont'd). CAR 512 - TWELVE PERCENT MISFIRE AND AIR TO BYPASS
1979 MERCURY MARQUIS - THREE-WAY CATALYST

	EMISSION RATE, MG/KM (Except as Noted)								
	UNMODIFIED			WITH MALFUNCTION CONDITION					
	FTP	SET	HFET	FTP	SET	HFET	FTP	SET	HFET
Test Number, PVM-ST	512-11	512-12	512-13	512-21	512-22	512-23	512-31	512-32	512-33
Aldehydes and Ketones									
Formaldehyde	6.43	4.12	2.32	0.53	0.04	0.34	1.29	0.19	0.10
Acetaldehyde	0.00	0.00	0.00	0.15	0.01	0.25	1.16	0.40	0.00
Acetone	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Isobutyraldehyde	0.00	0.00	0.00	0.20	0.22	1.67	0.35	0.23	0.13
Methyl Ethyl Ketone	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Crotonaldehyde	--	--	--	--	--	--	--	--	--
Hexanaldehyde	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzaldehyde	--	--	--	--	--	--	--	--	--
Aldehydes and Ketones	6.4	4.1	2.3	0.9	0.3	2.3	2.8	0.[illegible]	0.2
Total as % of THC, %	4.6	13.7	23.0	0.1	0.1	2.6	0.2	0.2	0.2
Individual Hydrocarbons									
Methane	53.69	22.85	7.92	42.73	12.92	4.01	44.73	14.48	4.41
Ethylene	4.08	0.60	0.00	19.46	6.36	3.49	17.19	6.24	3.33
Ethane	5.20	2.04	0.64	5.18	2.23	1.11	5.29	2.44	1.27
Acetylene	1.40	0.00	0.00	2.11	0.00	0.00	2.82	0.00	0.00
Propane	0.30	0.00	0.00	2.09	0.77	0.23	0.22	0.49	0.17
Propylene	1.57	0.00	0.00	12.32	6.14	3.82	10.66	5.85	3.50
Benzene	4.65	0.58	0.00	120.51	49.01	12.63	130.34	48.88	15.13
Toluene	4.33	0.06	0.00	120.48	15.65	3.88	109.63	16.23	1.69
Total Individual HC	75.2	26.1	8.6	324.9	93.1	29.2	320.9	94.6	29.5
Total as % of THC, %	53.7	87.0	86.0	17.9	29.1	32.4	19.7	24.9	29.5
Organic Sulfides									
Carbonyl Sulfide	--	--	--	0.04	0.01	0.02	0.13	0.04	0.04
Methyl Sulfide	--	--	--	0.05	0.03	0.02	0.07	0.00	0.03
Ethyl Sulfide	--	--	--	0.02	0.00	0.00	0.03	0.00	0.00
Methyl Disulfide	--	--	--	0.01	0.00	0.00	0.01	0.00	0.00
Organic Amines									
Monomethylamine	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.01
Monoethylamine	0.01	0.01	0.00	0.02	0.02	0.02	0.02	0.00	0.01
Trimethylamine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diethylamine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Triethylamine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE C- 2 (Cont'd). CAR 512 - TWELVE PERCENT MISFIRE AND AIR TO BYPASS
1979 MERCURY MARQUIS - THREE-WAY CATALYST

		EMISSION RATE, MG/KM (Except at Noted)								
		UNMODIFIED			WITH MALFUNCTION CONDITION					
		FTP	SET	HFET	FTP	SET	HFET	FTP	SET	HFET
Test Number, PVM-ST		512-11	512-12	512-13	512-21	512-22	512-23	512-31	512-32	512-33
Other Elements										
Chromium	Cr									
Lead	Pb	0.09	0.00	0.00	0.16	0.18	0.20	0.32	0.00	0.30
Manganese	Mn									
Arsenic	As									
Mercury	Hg									
Bromine	Br	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00
Phosphorus	P	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
Silicon	Si									
Cadmium	Cd									
Aluminum	Al	0.00	0.00	0.00	0.02	0.01	0.00	0.01	0.00	0.00
Sulfur	S	0.44	5.53	0.00	0.04	0.03	0.01	0.03	0.02	0.00
Sodium	Na	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
Fluorine	F									
Magnesium	Mg	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Potassium	K									
Chlorine	Cl	1.22	0.01	0.00	2.82	2.19	2.42	1.70	1.37	0.87
Platinum	Pt									
Zinc	Zn	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00
Copper	Cu	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00
Nickel	Ni									
Iron	Fe	0.13	0.03	0.00	0.53	0.31	0.06	0.46	0.12	0.03
Vanadium	V									
Titanium	Ti									
Barium	Ba	0.01	0.01	0.00	0.02	0.01	0.01	0.02	0.01	0.01
Calcium	Ca	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00

Note: Most values of 0.00 for Other Elements have been left blank.

TABLE C-3. CAR 513 - DISABLED EGR AND AIR
1979 MERCURY MARQUIS - THREE-WAY CATALYST

	EMISSION RATE, MG/KM (Except as Noted)								
	UNMODIFIED			WITH MALFUNCTION CONDITION					
	FTP	SET	HFET	FTP	SET	HFET	FTP	SET	HFET
Test Number, PVM-ST	513-11	513-12	513-13	513-21	513-22	513-23	513-31	513-32	513-33
Barometer, mm Hg	738.9	738.9	738.1	739.9	739.9	739.9	742.2	742.2	745.2
Humidity, g/kg	10.2	9.0	9.1	10.9	8.8	8.2	11.6	10.1	10.3
Temperature, °C	24.4	25.6	25.6	24.4	24.4	24.4	24.4	24.4	25.6
Total Fuel Sulfur, mg/km	34.42	25.81	22.69	37.02	26.78	24.68	36.34	26.66	23.72
Avg. Exh. Oxygen, %	---	---	---	0.43	0.21	0.20	0.71	0.51	0.29
Catalyst Avg. Temp., °C	---	---	---	401	492	642	399	540	619
Catalyst Max. Temp., °C	---	---	---	466	542	652	466	639	636
Carbon Dioxide, g/km	373.2	281.3	247.8	338.6	257.5	267.8	342.6	287.9	258.5
Fuel Cons., ℓ/100 km	16.06	12.04	10.59	17.27	12.50	11.52	16.96	12.44	11.07
Regulated Emissions									
Hydrocarbons, (THC), g/km	0.11	0.03	0.01	1.59	0.80	0.10	1.38	0.10	0.06
Carbon Monoxide, g/km	1.73	0.48	0.11	38.84	20.84	1.10	32.05	2.06	0.42
Oxides of Nitrogen, g/km	0.79	0.72	0.78	0.46	0.30	0.75	0.64	1.20	1.19
Particulates									
Total Particulates	4.67	18.23	42.84	9.22	6.45	3.61	2.38	5.04	0.60
Sulfate	0.72	11.52	26.80	0.18	0.11	0.17	0.16	0.15	0.11
Sulfate as % of TFS, %	0.70	14.88	39.37	0.16	0.14	0.23	0.15	0.19	0.15
Compound Group Totals									
Aldehydes & Ketones	0.0	0.9	0.6	1.7	0.1	1.0	4.1	1.2	0.7
Individual Hydrocarbons	60.7	26.3	7.4	587.9	340.0	35.4	385.2	51.1	19.3
Organic Sulfides	0.31	0.01	0.06	0.14	0.04	0.05	0.11	0.02	0.02
Organic Amines	0.00	0.01	0.02	0.08	0.03	0.00	0.02	0.00	0.01
Other Compounds									
Ammonia	8.51	---	---	174.67	---	---	170.09	---	---
Cyanide & Cyanogen	0.74	---	---	125.01	---	---	14.87	---	---
DMNA	---	---	---	---	---	---	---	---	---
Hydrogen Sulfide	0.00	0.00	0.00	0.54	1.04	0.55	0.15	0.38	0.25
Nickel Carbonyl	---	---	---	0.00	0.00	0.00	0.00	0.00	0.00
Nitrous Oxide	21.51	11.05	6.11	80.35	48.81	5.41	95.40	25.86	9.80

TABLE C-3 (CONT'D). CAR 513 - DISABLED EGR AND AIR
1979 MERCURY MARQUIS - THREE-WAY CATALYST

	EMISSION RATE, MG/KM (Except as Noted)								
	UNMODIFIED			WITH MALFUNCTION CONDITION					
	FTP	SET	HFET	FTP	SET	HFET	FTP	SET	HFET
Test Number, PVM-ST	513-11	513-12	513-13	513-21	513-22	513-23	513-31	513-32	513-33
Aldehydes and Ketones									
Formaldehyde	0.00	0.64	0.46	0.62	0.40	0.48	1.91	0.86	0.27
Acetaldehyde	0.00	0.18	0.14	0.82	0.31	0.15	0.00	0.00	0.00
Acetone	0.04	0.10	0.00	0.29	0.15	0.32	0.00	0.00	0.00
Isobutyraldehyde	0.00	0.00	0.00	0.00	0.00	0.00	2.19	0.36	0.39
Methyl Ethyl Ketone	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Crotonaldehyde	---	---	---	---	---	---	---	---	---
Hexanaldehyde	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzaldehyde	---	---	---	---	---	---	---	---	---
Aldehydes and Ketones	0.0	0.9	0.6	1.7	0.9	1.0	4.1	1.2	0.7
Total as % of THC, %	0.0	3.0	6.0	0.1	0.1	1.0	0.3	1.2	1.2
Individual Hydrocarbons									
Methane	37.87	21.41	6.70	117.55	69.61	9.83	88.05	21.87	6.92
Ethylene	5.07	0.73	0.01	162.16	78.79	3.60	92.86	3.77	1.61
Ethane	4.73	1.83	0.50	20.61	14.29	2.78	13.84	3.44	1.60
Acetylene	1.24	0.00	0.00	3.62	0.00	0.00	2.67	0.00	0.00
Propane	0.70	0.00	0.00	0.00	1.01	0.00	0.88	0.54	0.00
Propylene	2.17	0.00	0.00	70.34	37.39	2.85	37.49	2.11	1.32
Benzene	5.09	1.93	0.09	95.26	68.40	11.05	60.70	14.17	5.06
Toluene	3.79	0.40	0.05	118.40	70.52	5.28	88.67	5.16	2.83
Total Individual HC	60.7	26.3	7.4	587.9	340.0	35.4	385.2	51.1	19.3
Total as % of THC, %	55.2	87.7	74.0	37.0	42.5	35.4	27.9	51.1	32.2
Organic Sulfides									
Carbonyl Sulfide	0.23	0.00	0.06	0.07	0.03	0.04	0.05	0.01	0.01
Methyl Sulfide	0.07	0.01	0.00	0.02	0.01	0.01	0.01	0.01	0.01
Ethyl Sulfide	0.01	0.00	0.00	0.04	0.00	0.00	0.03	0.00	0.00
Methyl Disulfide	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00
Organic Amines									
Monomethylamine	0.00	0.01	0.02	0.03	0.03	0.00	0.01	0.00	0.01
Monoethylamine	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00
Trimethylamine	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
Diethylamine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Triethylamine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE C-3 (Cont'd). CAR 513 - DISABLED EGR AND AIR
1979 MERCURY MARQUIS - THREE-WAY CATALYST

		EMISSION RATE, MG/KM (Except at Noted)								
		UNMODIFIED			WITH MALFUNCTION CONDITION					
		FTP	SET	HFET	FTP	SET	HFET	FTP	SET	HFET
Test Number, PVM-ST		513-11	513-12	513-13	513-21	513-22	513-23	513-31	513-32	513-33
Other Elements										
Chromium	Cr									
Lead	Pb	0.00	0.00	0.00	0.09	0.00	0.00	0.11	0.00	0.00
Manganese	Mn									
Arsenic	As									
Mercury	Hg									
Bromine	Br									
Phosphorus	P	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Silicon	Si	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00
Cadmium	Cd									
Aluminum	Al	0.01	0.00	0.00	0.01	0.01	0.00	0.03	0.00	0.01
Sulfur	S	0.06	2.83	10.93	0.07	0.22	0.11	0.98	1.65	3.98
Sodium	Na									
Fluorine	F									
Magnesium	Mg									
Potassium	K	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Chlorine	Cl	0.01	0.00	0.00	0.02	0.02	0.01	0.02	0.01	0.02
Platinum	Pt									
Zinc	Zn	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00
Copper	Cu									
Nickel	Ni									
Iron	Fe	0.18	0.03	0.00	0.13	0.09	0.02	0.93	0.00	0.38
Vanadium	V									
Titanium	Ti									
Barium	Ba	0.01	0.01	0.01	0.01	0.00	0.00	0.02	0.00	0.02
Calcium	Ca	0.00	0.00	0.00	0.04	0.01	0.00	0.01	0.00	0.01

Note: Most values of 0.00 for Other Elements have been left blank.

TABLE C-4. CAR 514 - DISCONNECTED CTS
1979 MERCURY MARQUIS - THREE-WAY CATALYST

	EMISSION RATE, MG/KM (Except as Noted)								
	UNMODIFIED			WITH MALFUNCTION CONDITION					
	FTP	SET	HFET	FTP	SET	HFET	FTP	SET	HFET
Test Number, PVM-ST	514-11	514-12	514-13	514-21	514-22	514-23	514-31	514-32	514-33
Barometer, mm Hg	735.1	735.1	735.1	746.3	746.3	746.3	745.0	746.3	746.3
Humidity, g/kg	11.7	11.0	10.0	8.8	8.1	7.3	10.1	7.7	8.7
Temperature, °C	24.4	26.1	26.7	21.1	22.8	23.3	24.4	23.9	24.4
Total Fuel Sulfur, mg/km	34.26	24.33	21.89	39.61	27.89	25.64	39.61	27.84	25.66
Avg. Exh. Oxygen, %	3.69	3.69	2.93	0.43	0.25	0.08	0.12	0.19	0.08
Catalyst Avg. Temp., °C	475	543	591	436	519	573	---	522	583
Catalyst Max. Temp., °C	563	606	627	529	597	614	525	601	618
Carbon Dioxide, g/km	371.3	265.4	239.2	341.3	244.1	226.1	348.6	245.3	227.4
Fuel Cons., ℓ/100 km	15.99	11.35	10.21	18.48	13.01	11.96	18.48	12.99	11.97
Regulated Emissions									
Hydrocarbons, (THC), g/km	0.14	0.03	0.01	1.83	1.04	0.86	1.76	1.06	0.84
Carbon Monoxide, g/km	1.77	0.29	0.03	54.67	36.62	32.73	50.14	35.49	32.08
Oxides of Nitrogen, g/km	0.76	0.73	0.79	0.34	0.26	0.21	0.39	0.26	0.21
Particulates									
Total Particulates	1.35	23.39	53.71	8.02	3.74	3.25	14.65	7.23	1.89
Sulfate	0.76	16.21	40.93	0.21	0.12	0.07	0.20	0.09	0.05
Sulfate as % of TFS, %	0.74	22.21	62.33	0.18	0.14	0.09	0.17	0.11	0.06
Compound Group Totals									
Aldehydes & Ketones	3.3	2.2	1.7	2.7	0.9	0.0	---	0.2	1.9
Individual Hydrocarbons	75.2	22.9	10.4	724.2	456.4	383.9	719.6	470.0	382.5
Organic Sulfides	0.17	0.27	0.05	0.34	0.07	0.18	---	0.23	0.21
Organic Amines	0.00	0.00	0.00	0.01	0.02	0.00	0.03	0.00	0.04
Other Compounds									
Ammonia	6.05	---	---	237.15	---	---	268.79	---	---
Cyanide & Cyanogen	0.48	---	---	79.42	---	---	145.15	---	---
DMNA	---	---	---	---	---	---	---	---	---
Hydrogen Sulfide	0.00	0.00	0.00	0.93	1.63	2.34	0.99	2.37	4.02
Nickel Carbonyl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nitrous Oxide	23.85	9.34	5.27	41.36	14.20	8.61	44.02	20.04	9.14

TABLE C-4 (CONT'D). CAR 514 - DISCONNECTED CTS
1979 MERCURY MARQUIS - THREE-WAY CATALYST

	EMISSION RATE, MG/KM (Except as Noted)								
	UNMODIFIED			WITH MALFUNCTION CONDITION					
	FTP	SET	HFET	FTP	SET	HFET	FTP	SET	HFET
Test Number, PVM-ST	514-11	514-12	514-13	514-21	514-22	514-23	514-31	514-32	514-33
Aldehydes and Ketones									
Formaldehyde	2.91	2.05	1.55	0.16	0.00	0.00	0.28	0.02	0.03
Acetaldehyde	0.11	0.00	0.00	1.18	0.48	0.00	1.16	0.23	0.00
Acetone	0.00	0.00	0.00	1.16	0.45	0.00	1.03	0.00	0.00
Isobutyraldehyde	0.31	0.11	0.18	0.00	0.00	0.00	---	0.00	1.89
Methyl Ethyl Ketone	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00
Crotonaldehyde	---	---	---	---	---	---	---	---	---
Hexanaldehyde	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzaldehyde	---	---	---	---	---	---	---	---	---
Aldehydes and Ketones	3.3	2.2	1.7	2.7	0.9	0.0	---	0.2	1.9
Total as % of THC, %	2.4	7.3	17.0	0.1	0.1	0.0	---	0.0	0.2
Individual Hydrocarbons									
Methane	48.72	19.84	9.53	137.70	82.60	70.05	141.79	85.78	74.20
Ethylene	5.60	0.55	0.00	187.24	109.07	92.37	183.89	114.17	94.68
Ethane	4.11	1.51	0.31	17.90	12.02	11.26	19.99	13.28	12.28
Acetylene	1.84	0.00	0.00	3.20	0.00	0.00	3.34	0.00	0.00
Propane	1.14	0.11	0.51	2.02	1.20	1.03	3.10	1.28	1.07
Propylene	1.80	0.00	0.00	75.66	50.77	47.36	76.38	53.59	47.31
Benzene	4.80	0.59	0.00	103.77	79.12	70.43	105.60	79.54	67.29
Toluene	7.15	0.29	0.00	196.68	121.64	91.39	185.55	122.40	85.70
Total Individual HC	75.2	22.9	10.4	724.2	456.4	383.9	719.6	470.0	382.5
Total as % of THC, %	53.7	76.3	104.0	39.6	43.9	44.6	40.9	44.3	45.5
Organic Sulfides									
Carbonyl Sulfide	0.08	0.05	0.02	0.11	0.04	0.05	---	0.13	0.10
Methyl Sulfide	0.04	0.07	0.03	0.06	0.03	0.05	---	0.07	0.07
Ethyl Sulfide	0.02	0.10	0.00	0.14	0.00	0.04	---	0.01	0.02
Methyl Disulfide	0.03	0.05	0.00	0.03	0.00	0.04	---	0.02	0.02
Organic Amines									
Monomethylamine	0.00	0.00	0.00	0.01	0.02	0.00	0.03	0.00	0.04
Monoethylamine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Trimethylamine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diethylamine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Triethylamine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE C-4 (Cont'd). CAR 514 - DISCONNECTED CTS
1979 MERCURY MARQUIS - THREE-WAY CATALYST

		EMISSION RATE, MG/KM (Except at Noted)								
		UNMODIFIED			WITH MALFUNCTION CONDITION					
		FTP	SET	HFET	FTP	SET	HFET	FTP	SET	HFET
Test Number, PVM-ST		514-11	514-12	514-13	514-21	514-22	514-23	514-31	514-32	514-33
Other Elements										
Chromium	Cr									
Lead	Pb	0.20	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00
Manganese	Mn									
Arsenic	As									
Mercury	Hg									
Bromine	Br									
Phosphorus	P	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.00
Silicon	Si	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00
Cadmium	Cd									
Aluminum	Al	0.01	0.00	0.00	0.04	0.01	0.00	0.03	0.01	0.00
Sulfur	S	0.15	6.21	11.48	0.06	0.03	0.01	0.06	0.03	0.01
Sodium	Na									
Fluorine	F									
Magnesium	Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
Potassium	K	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Chlorine	Cl	0.03	0.00	0.01	0.05	0.03	0.02	0.04	0.14	0.01
Platinum	Pt									
Zinc	Zn	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00
Copper	Cu									
Nickel	Ni									
Iron	Fe	0.14	0.03	0.00	0.27	0.09	0.04	0.23	0.08	0.00
Vanadium	V									
Titanium	Ti									
Barium	Ba	0.02	0.01	0.00	0.02	0.01	0.01	0.03	0.01	0.00
Calcium	Ca	0.01	0.00	0.01	0.02	0.01	0.00	0.00	0.01	0.00

Note: Most values of 0.00 for Other Elements have been left blank.

APPENDIX D

FTP INDIVIDUAL SAMPLE EMISSIONS RESULTS

TABLE D-1. FTP INDIVIDUAL SAMPLE EMISSIONS RESULTS
Test Series 511 - Disabled O_2 Sensor

Emissions in mg/km

	Unmodified		Malfunction			
	511-11		511-21		511-31	
	COLD-UDDS	HOT-UDDS	COLD-UDDS	HOT-UDDS	COLD-UDDS	HOT-UDDS
Total Particulate	6.68	2.61	5.60	1.10	9.04	8.32
Sulfates	0.21	0.23	0.10	0.19	0.58	3.86
Ammonia	1.84	2.55	4.52	3.82	3.35	2.13
Cyanides & Cyanogen	0.00	0.00	0.24	0.05	--	0.33
Hydrogen Sulfide	0.00	0.00	0.00	0.00	0.00	0.00
Aldehydes & Ketones						
Formaldehyde	0.15	0.39	0.00	0.00	0.00	0.00
Acetaldehyde	0.00	0.59	0.00	0.00	0.56	0.00
Acetone	0.00	0.00	0.00	0.00	0.00	0.00
Isobutyraldehyde	0.00	0.00	0.00	0.30	0.20	0.00
Methyl ethyl ketone	0.00	0.00	0.37	0.17	0.00	0.00
Crotonaldehyde	--	--	--	--	--	--
Hexanaldehyde	0.00	0.00	0.00	0.00	0.00	0.00
Benzaldehyde	--	--	--	--	--	--
Organic Sulfides						
Carbonyl sulfide	0.10	0.08	0.05	0.04	0.27	0.33
Methyl sulfide	0.00	0.04	0.02	0.01	0.35	0.21
Ethyl sulfide	0.04	0.00	0.17	0.00	0.53	0.16
Methyl disulfide	0.02	0.00	0.06	0.00	0.27	0.11
Organic Amines						
Monomethylamine	0.00	0.00	0.00	0.00	0.00	0.00
Monoethylamine & dimethylamine	0.00	0.00	0.00	0.00	0.00	0.00
Trimethylamine	0.00	0.00	0.00	0.00	0.00	0.00
Diethylamine	0.00	0.00	0.00	0.00	0.00	0.00
Triethylamine	0.00	0.00	0.00	0.00	0.00	0.00

Emissions in ppm

	COLD-UDDS		HOT-UDDS		COLD-UDDS		HOT-UDDS		COLD-UDDS		HOT-UDDS	
	1	2	3	4	1	2	3	4	1	2	3	4
Individual Hydrocarbons												
Methane	5.98	2.67	3.47	2.65	5.94	2.84	4.06	2.23	7.21	3.52	5.68	2.90
Ethylene	2.04	0.02	0.37	0.00	1.72	0.08	0.10	0.00	2.37	0.01	0.42	0.00
Ethane	0.57	0.28	0.63	0.29	0.49	0.06	0.29	0.02	0.65	0.00	0.43	0.00
Acetylene	1.24	0.00	0.00	0.00	0.88	0.00	0.00	0.00	1.21	0.00	0.00	0.00
Propane	0.16	0.03	0.00	0.00	0.14	0.05	0.05	0.00	0.11	0.00	0.00	0.00
Propylene	1.00	0.00	0.21	0.00	0.91	0.00	0.05	0.00	1.16	0.00	0.00	0.00
Benzene	1.83	0.14	0.49	0.01	1.34	0.00	0.10	0.00	1.75	0.00	0.25	0.00
Toluene	3.99	0.07	0.25	0.00	2.56	0.00	0.10	0.00	3.41	0.00	0.24	0.00
Other												
Nitrous Oxide	0.97	0.34	1.20	0.41	1.00	0.13	0.34	0.09	0.90	0.11	0.37	0.10
Nickel Carbonyl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE D-2. FTP INDIVIDUAL SAMPLE EMISSIONS RESULTS
Test Series 512 - Twelve Percent Misfire and Air to Bypass

Emissions in mg/km

	Unmodified		Malfunction			
	512-11		512-21		512-31	
	COLD-UDDS	HOT-UDDS	COLD-UDDS	HOT-UDDS	COLD-UDDS	HOT-UDDS
Total Particulate	7.66	4.61	18.94	4.53	12.52	6.83
Sulfates	0.90	2.28	0.21	0.04	0.22	0.09
Ammonia	2.93	3.78	7.55	33.18	15.32	58.10
Cyanides & Cyanogen	0.00	0.00	2.30	1.51	0.87	1.60
Hydrogen Sulfide	0.00	0.00	0.90	0.56	0.43	0.49
Aldehydes & Ketones						
Formaldehyde	6.53	6.35	0.79	0.34	1.93	0.80
Acetaldehyde	0.00	0.00	0.16	0.45	1.30	1.06
Acetone	0.00	0.00	0.00	0.00	0.00	0.00
Isobutyraldehyde	0.00	0.00	0.15	0.24	0.21	0.46
Methyl ethyl ketone	0.00	0.00	0.00	0.00	0.00	0.00
Crotonaldehyde	--	--	--	--	--	--
Hexanaldehyde	0.00	0.00	0.00	0.00	0.00	0.00
Benzaldehyde	--	--	--	--	--	--
Organic Sulfides						
Carbonyl sulfide	--	--	0.06	0.02	0.05	0.19
Methyl sulfide	--	--	0.01	0.08	0.02	0.10
Ethyl sulfide	--	--	0.05	0.00	0.06	0.00
Methyl disulfide	--	--	0.02	0.00	0.00	0.01
Organic Amines						
Monomethylamine	0.00	0.00	0.00	0.00	0.02	0.05
Monoethylamine & dimethylamine	0.00	0.01	0.00	0.01	0.03	0.01
Trimethylamine	0.00	0.00	0.00	0.00	0.00	0.00
Diethylamine	0.00	0.00	0.00	0.00	0.00	0.00
Triethylamine	0.00	0.00	0.00	0.00	0.00	0.00

Emissions in ppm

	COLD-UDDS		HOT-UDDS		COLD-UDDS		HOT-UDDS		COLD-UDDS		HOT-UDDS	
	1	2	3	4	1	2	3	4	1	2	3	4
Individual Hydrocarbons												
Methane	6.83	4.22	4.54	3.55	8.97	2.05	4.57	1.69	7.20	2.36	5.22	2.15
Ethylene	1.98	0.09	0.38	0.00	6.97	0.60	2.32	0.65	4.96	0.63	2.51	0.66
Ethane	0.64	0.40	0.69	0.35	1.11	0.27	0.73	0.24	0.78	0.32	0.83	0.29
Acetylene	0.96	0.00	0.00	0.00	1.46	0.00	0.00	0.00	1.89	0.00	0.02	0.00
Propane	0.01	0.00	0.01	0.07	0.48	0.23	0.20	0.06	0.06	0.01	0.06	0.00
Propylene	0.94	0.01	0.03	0.00	3.97	0.43	1.54	0.52	2.39	0.48	1.81	0.48
Benzene	2.05	0.05	0.34	0.00	24.21	10.84	14.04	9.79	16.38	10.16	23.78	10.55
Toluene	2.99	0.00	0.08	0.00	49.10	3.48	15.20	3.30	35.31	4.33	16.68	3.82
Other												
Nitrous Oxide	1.55	0.45	1.62	0.53	1.61	0.14	0.40	0.11	0.95	0.15	0.26	0.09
Nickel Carbonyl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE D-3. FTP INDIVIDUAL SAMPLE EMISSIONS RESULTS

Test Series 513 - Disabled EGR and Air

	Emissions in mg/km					
	Unmodified		Malfunction			
	513-11		513-21		513-31	
	COLD-UDDS	HOT-UDDS	COLD-UDDS	HOT-UDDS	COLD-UDDS	HOT-UDDS
Total Particulate	6.63	3.20	11.41	7.57	0.58	3.73
Sulfates	0.93	0.56	0.29	0.09	0.18	0.15
Ammonia	9.46	7.79	129.64	208.64	196.09	150.48
Cyanides & Cyanogen	1.46	0.19	139.03	114.44	18.56	12.08
Hydrogen Sulfide	0.00	0.00	0.65	0.46	0.34	0.00
Aldehydes & Ketones						
Formaldehyde	0.00	0.00	0.90	0.40	0.37	3.07
Acetaldehyde	0.00	0.00	0.14	1.33	0.00	0.00
Acetone	0.09	0.00	0.34	0.26	0.00	0.00
Isobutyraldehyde	0.00	0.00	0.00	0.00	4.25	0.63
Methyl ethyl ketone	0.00	0.00	0.00	0.00	0.00	0.00
Crotonaldehyde	----	----	----	----	----	----
Hexanaldehyde	0.00	0.00	0.00	0.00	0.00	0.00
Benzaldehyde	----	----	----	----	----	----
Organic Sulfides						
Carbonyl sulfide	0.50	0.02	0.05	0.08	0.06	0.05
Methyl sulfide	0.14	0.01	0.02	0.02	0.00	0.02
Ethyl sulfide	0.03	0.00	0.09	0.00	0.06	0.00
Methyl disulfide	0.00	0.00	0.03	0.00	0.02	0.00
Organic Amines						
Monomethylamine	0.00	0.00	0.00	0.05	0.00	0.01
Monoethylamine & dimethylamine	0.00	0.00	0.00	0.08	0.00	0.00
Trimethylamine	0.00	0.00	0.00	0.00	0.00	0.01
Diethylamine	0.00	0.00	0.00	0.00	0.00	0.00
Triethylamine	0.00	0.00	0.00	0.00	0.00	0.00

	Emissions in ppm											
	COLD-UDDS		HOT-UDDS		COLD-UDDS		HOT-UDDS		COLD-UDDS		HOT-UDDS	
	1	2	3	4	1	2	3	4	1	2	3	4
Individual Hydrocarbons												
Methane	6.45	3.93	4.15	3.53	14.02	9.66	10.91	8.01	13.07	8.21	8.16	3.83
Ethylene	2.16	0.12	0.46	0.10	21.42	16.49	15.94	13.76	18.90	14.15	10.71	0.32
Ethane	0.64	0.35	0.58	0.32	2.53	1.51	2.74	1.47	2.29	1.36	1.95	0.38
Acetylene	0.85	0.00	0.01	0.00	1.86	0.24	0.08	0.04	1.79	0.00	0.00	0.00
Propane	0.16	0.11	0.03	0.01	0.00	0.00	0.00	0.00	0.23	0.08	0.10	0.01
Propylene	1.11	0.01	0.18	0.00	9.65	6.96	6.69	6.11	8.02	5.87	4.00	0.03
Benzene	1.91	0.20	0.59	0.18	14.31	9.31	10.42	9.02	12.91	8.77	6.44	1.94
Toluene	3.18	0.17	0.33	0.05	3.41	15.46	14.27	13.48	19.36	14.38	10.07	0.75
Other												
Nitrous Oxide	1.51	0.41	1.29	0.05	4.46	1.88	3.76	1.38	5.38	2.80	4.56	1.09
Nickel Carbonyl	----	----	----	----	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE D-4. FTP INDIVIDUAL SAMPLE EMISSIONS RESULTS
Test Series 514 - Disconnected CTS

	Emissions in mg/km					
	Unmodified		Malfunction			
	514-11		514-21		514-31	
	COLD-UDDS	HOT-UDDS	COLD-UDDS	HOT-UDDS	COLD-UDDS	HOT-UDDS
Total Particulate	3.14	0.00	6.31	9.31	20.10	10.53
Sulfates	0.52	0.94	0.28	0.15	0.31	0.11
Ammonia	8.62	4.11	192.44	270.88	253.41	280.40
Cyanides & Cyanogen	0.90	0.17	80.93	78.28	172.30	124.66
Hydrogen Sulfide	0.00	0.00	0.59	1.18	0.68	1.23
Aldehydes & Ketones						
Formaldehyde	3.80	2.23	0.37	0.00	0.42	0.18
Acetaldehyde	0.00	0.20	1.29	1.09	0.74	1.47
Acetone	0.00	0.00	1.07	1.23	0.33	1.55
Isobutyraldehyde	0.31	0.31	0.00	0.00	0.00	----
Methyl ethyl ketone	0.00	0.00	0.00	0.29	0.00	0.00
Crotonaldehyde	----	----	----	----	----	----
Hexanaldehyde	0.00	0.00	0.00	0.00	0.00	0.00
Benzaldehyde	----	----	----	----	----	----
Organic Sulfides						
Carbonyl sulfide	0.05	0.11	0.00	0.19	----	0.07
Methyl sulfide	0.00	0.07	0.00	0.11	----	0.03
Ethyl sulfide	0.05	0.00	0.33	0.00	----	0.00
Methyl disulfide	0.04	0.03	0.08	0.00	----	0.00
Organic Amines						
Monomethylamine	0.00	0.00	0.00	0.01	0.05	0.01
Monoethylamine & dimethylamine	0.00	0.00	0.00	0.00	0.00	0.00
Trimethylamine	0.00	0.00	0.00	0.00	0.00	0.00
Diethylamine	0.00	0.00	0.00	0.00	0.00	0.00
Triethylamine	0.00	0.00	0.00	0.00	0.00	0.00

	Emissions in ppm											
	COLD-UDDS		HOT-UDDS		COLD-UDDS		HOT-UDDS		COLD-UDDS		HOT-UDDS	
	1	2	3	4	1	2	3	4	1	2	3	4
Individual Hydrocarbons												
Methane	6.67	3.00	4.16	3.28	15.04	9.82	12.89	10.36	17.74	10.62	13.59	9.77
Ethylene	2.82	0.10	0.42	0.00	21.95	16.72	20.57	17.11	24.79	16.24	19.80	15.54
Ethane	0.65	0.23	0.56	0.24	2.30	1.18	2.51	1.17	2.67	1.39	2.78	1.23
Acetylene	1.24	0.00	0.00	0.00	2.00	0.10	0.00	0.00	1.13	0.38	0.17	0.10
Propane	0.16	0.10	0.10	0.10	0.28	0.12	0.24	0.18	0.39	0.28	0.27	0.26
Propylene	1.20	0.00	0.06	0.00	9.11	6.63	8.53	6.78	10.09	6.67	8.17	6.62
Benzene	2.49	0.05	0.39	0.05	14.13	9.52	13.27	9.52	15.81	8.94	13.03	9.76
Toluene	4.28	0.05	0.31	0.00	26.64	18.70	22.03	18.86	26.91	17.90	19.06	17.57
Other												
Nitrous Oxide	1.52	0.37	1.06	0.42	3.14	0.64	1.67	0.67	3.21	0.79	1.94	0.57
Nickel Carbonyl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

APPENDIX E

COMPUTER PRINTOUTS OF THE REGULATED EMISSIONS TESTS RESULTS

TABLE E-1. TEST NO. 511-11 EMISSIONS RESULTS

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                        PVM - 511    FTP  VEHICLE EMISSIONS RESULTS - UNMODIFIED
                                          PROJECT 11-5402-001

TEST NO.   511-11   RUN   1                 VEHICLE NO.   51                     TEST WEIGHT   2041 KG(  4500 LBS)
VEHICLE MODEL   79 MERCURY MARQUIS          DATE    4/20/79                      ACTUAL ROAD LOAD   8.9 KW( 12.0 HP)
ENGINE 5.7 L(351 CID) V-8                   BAG CART NO.  1                      GASOLINE  EM-344
TRANSMISSION A3                             DYNO NO.      3                      ODOMETER   3524 KM(  2190 MILES)
GVW  2434 KG(  5365 LBS)                    CVS NO.       2

BAROMETER 740.16 MM HG(29.14 IN HG)         DRY BULB TEMP. 25.6 DEG C(78.0 DEG F)
RELATIVE HUMIDITY 53 PCT                    ABS. HUMIDITY 11.1 GM/KG             NOX HUMIDITY CORRECTION FACTOR  1.01
BAG RESULTS
   BAG NUMBER                                      1                  2                    3                   4
   DESCRIPTION                              COLD TRANSIENT       STABILIZED         HOT TRANSIENT         STABILIZED

   BLOWER DIF P MM. H2O(IN. H2O)             787.4 (31.0)       787.4 (31.0)        787.4 (31.0)        787.4 (31.0)
   BLOWER INLET P MM. H2O(IN. H2O)           774.7 (30.5)       774.7 (30.5)        774.7 (30.5)        774.7 (30.5)
   BLOWER INLET TEMP. DEG. C(DEG. F)          43.3 (110.0)       43.3 (110.0)        43.3 (110.0)        43.3 (110.0)
   BLOWER REVOLUTIONS                           40665              69879               40552               69643
   CVS FLOW STD. CU. METRES(SCF)              75.9 (2680.7)     130.4 (4605.8)       75.7 (2673.0)      130.0 (4590.0)
   HC  SAMPLE METER/RANGE/PPM                51.6/ 2/   52      14.2/ 2/   14       17.6/ 2/   18       12.9/ 2/   13
   HC  BCKGRD METER/RANGE/PPM                10.3/ 2/   10       9.9/ 2/   10        9.1/ 2/    9        8.5/ 2/    9
   CO  SAMPLE METER/RANGE/PPM                69.7/11/  297      22.5/13/   21       65.9/13/   64       15.7/13/   15
   CO  BCKGRD METER/RANGE/PPM                 1.5/11/    5       3.2/13/    3        2.8/13/    3        1.6/13/    2
   CO2 SAMPLE METER/RANGE/PCT                87.0/ 3/ 1.62      56.0/ 3/  .98       79.3/ 3/ 1.46       59.1/ 3/ 1.05
   CO2 BCKGRD METER/RANGE/PCT                 3.6/ 3/  .06       3.0/ 3/  .05        3.4/ 3/  .05        3.5/ 3/  .05
   NOX SAMPLE METER/RANGE/PPM                58.0/ 2/   58      15.8/ 2/   16       36.6/ 2/   37       17.1/ 2/   17
   NOX BCKGRD METER/RANGE/PPM                 1.7/ 2/    2       1.5/ 2/    2         .9/ 2/    1         .7/ 2/    1
   DILUTION FACTOR                               8.13              13.57                9.16               12.79

   HC  CONCENTRATION PPM                          43                 5                    9                   5
   CO  CONCENTRATION PPM                         278                18                   59                  13
   CO2 CONCENTRATION PCT                        1.57               .44                 1.41                1.00
   NOX CONCENTRATION PPM                        56.5              14.4                 35.8                16.5
   HC  MASS GRAMS                               1.86               .38                  .41                 .38
   CO  MASS GRAMS                              24.61              2.70                 5.17                1.97
   CO2 MASS GRAMS                             2178.1            2248.2               1952.5              2369.6
   NOX MASS GRAMS                               8.32              3.65                 5.26                4.15

   HC  GRAMS/KM                                  .32               .06                  .07                 .06
   CO  GRAMS/KM                                 4.24               .44                  .89                 .32
   CO2 GRAMS/KM                                375.4             363.1                337.3               385.8
   NOX GRAMS/KM                                 1.43               .59                  .91                 .68
   FUEL CONSUMPTION BY CB L/100KM              16.35             15.53                14.47               16.49

   RUN TIME              SECONDS                 505               870                  505                 868
   AVG. EXH. OXYGEN      PERCENT                3.55              3.61                 3.54                3.55
   CATALYST AVG. TEMP.   DEG. C                   -                 -                    -                   -
   CATALYST MAX. TEMP.   DEG. C                   -                 -                    -                   -
   MEASURED DISTANCE     KM                     5.80              6.19                 5.79                6.14
        DFC, WET (DRY)                               .908 ( .898)                            .910 ( .901)
        SCF, WET (DRY)                              1.000 ( .978)                           1.000 ( .978)
        VOL (SCM)                                           206.3                                   205.6
        KM  (MEASURED)                                      11.99                                   11.93

COMPOSITE RESULTS                                                                                 3-BAG        (4-BAG)
   TEST NUMBER          511-11        TOTAL FUEL SULFUR   MG/KM   33.02     CARBON DIOXIDE       G/KM     358.5      ( 365.2)
   BAROMETER    MM HG   740.2         AVG. EXH. OXYGEN    PCT      3.59     FUEL CONSUMPTION     L/100KM   15.41     ( 15.69)
   HUMIDITY     G/KG     11.1         CATALYST AVG. TEMP. DEG C     -       HYDROCARBONS (THC)   G/KM        .12     (   .12)
   TEMPERATURE  DEG C    25.6         CATALYST MAX. TEMP. DEG C     -       CARBON MONOXIDE      G/KM       1.35     (  1.32)
                                                                            OXIDES OF NITROGEN   G/KM        .85     (   .88)
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TABLE E-2. TEST NO. 511-12 EMISSIONS RESULTS

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                         PVM - 511   SBT  VEHICLE EMISSIONS RESULTS - UNMODIFIED
                                            PROJECT 11-5402-001

                                          VEHICLE NO.     51                               TEST WEIGHT   2041 KG(  4500 LBS)
VEHICLE MODEL   79 MERCURY MARQUIS        TRANSMISSION A3                                  ACTUAL ROAD LOAD   8.9 KW( 12.0 HP)
ENGINE 5.7 L(351 CID) V-8                 GVW  2434 KG(  5365 LBS)                         GASOLINE  EM-344

  TEST NUMBER                                  511-12                   511-13
  TEST CYCLE                                    SET                      HFET
  RUN NUMBER                                     1                        1
  DATE                                        4/20/79                  4/20/79                         /  /
  ODOMETER                               3553KM(  2208MILES)      3589KM(  2230MILES)
  CVS - BAG CART - DYNAMOMETER                2 - 1 - 3                2 - 1 - 3

  TEMPERATURE DEG. C (DEG. F)              . 27.2 / 81.0             26.7 / 80.0
  RELATIVE HUMIDITY, PCT                       42.0                     41.3
  BAROMETER, MM HG(IN HG)                  739.9 (29.13)            739.9 (29.13)
  RUN TIME, SECONDS                            1398                      766

  BLOWER DIF P MM. H2O(IN. H2O)            787.4 (31.0)             787.4 (31.0)
  BLOWER INLET P MM. H2O(IN. H2O)          774.7 (30.5)             774.7 (30.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)         43.3 (110.0)             43.3 (110.0)
  BLOWER REVOLUTIONS                          112786                    61881
  CVS FLOW STD. CU. METRES(SCF)            210.4 (7432.6)           115.5 (4078.3)
  HC   SAMPLE METER/RANGE/PPM              13.2/ 2/   13            11.0/ 2/   11
  HC   BCKGRD METER/RANGE/PPM               9.9/ 2/   10            10.4/ 2/   10
  CO   SAMPLE METER/RANGE/PPM              22.8/13/   22             4.0/13/    4
  CO   BCKGRD METER/RANGE/PPM               3.6/13/    4             2.3/13/    2
  CO2  SAMPLE METER/RANGE/PCT              87.0/ 3/ 1.62            43.4/ 2/ 1.92
  CO2  BCKGRD METER/RANGE/PCT               3.2/ 3/  .05             1.6/ 2/  .06
  NOX  SAMPLE METER/RANGE/PPM              42.9/ 2/   43            62.0/ 2/   62
  NOX  BCKGRD METER/RANGE/PPM               1.0/ 2/    1             1.2/ 2/    1
  HC   CONCENTRATION PPM                         4                        2
  CO   CONCENTRATION PPM                        18                        2
  CO2  CONCENTRATION PCT                       1.57                     1.87
  NOX  CONCENTRATION PPM                       42.0                     61.0
  HC   MASS GRAMS                              .55                      .14
  CO   MASS GRAMS                              4.32                     .24
  CO2  MASS GRAMS                             6059.6                   3952.9
  NOX  MASS GRAMS                             16.37                    12.84
       DFC, WET (DRY)                     .879 ( .873)             .857 ( .851)
       SCF, WET (DRY)                    1.000 ( .978)            1.000 ( .975)
       VOL (SCM)                              210.4                    115.5
       KM  (MEASURED)                         21.52                    16.31

  TEST NUMBER,           PVM-ST               511-12                   511-13
  BAROMETER,             MM HG                739.9                    739.9
  HUMIDITY,              G/KG                  9.7                      9.2
  TEMPERATURE,           DFG C                 27.2                     26.7
  TOTAL FUEL SULFUR,     MG/KM                25.79                    22.18

  AVG. EXH. OXYGEN,      PCT                   3.45                     2.96
  CATALYST AVG. TEMP.,   DEG C                  -                        -
  CATALYST MAX. TEMP.,   DEG C                  -                        -
  CARBON DIOXIDE,        G/KM                 281.6                    242.4
  FUEL CONSUMPTION,      L/100KM              12.04                    10.35

  HYDROCARBONS,          G/KM                  .03                      .01
  CARBON MONOXIDE,       G/KM                  .20                      .01
  OXIDES OF NITROGEN,    G/KM                  .76                      .79
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TABLE E-3. TEST NO. 511-21 EMISSIONS RESULTS

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PVM - 511   FTP  VEHICLE EMISSIONS RESULTS - DISABLED 02 SENSOR
                 PROJECT 11-5402-001

TEST NO.   511-21   RUN   1            VEHICLE NO.   51                  TEST WEIGHT   2041 KG(  4500 LBS)
VEHICLE MODEL   79 MERCURY MARQUIS     DATE    4/26/79                   ACTUAL ROAD LOAD   8.9 KW( 12.0 HP)
ENGINE 5.7 L(351 CID) V-8              BAG CART NO.  1                   GASOLINE  EM-344
TRANSMISSION A3                        DYNO NO.      3                   ODOMETER   4054 KM(  2519 MILES)
GVW  2434 KG(  5365 LBS)               CVS NO.       2

BAROMETER 737.62 MM HG(29.04 IN HG)    DRY BULB TEMP. 24.4 DEG C(76.0 DEG F)
RELATIVE HUMIDITY 52 PCT               ABS. HUMIDITY 10.2 GM/KG          NOX HUMIDITY CORRECTION FACTOR   .98
BAG RESULTS
   BAG NUMBER                                  1                 2                3                 4
   DESCRIPTION                           COLD TRANSIENT      STABILIZED      HOT TRANSIENT       STABILIZED

   BLOWER DIF P MM. H2O(IN. H2O)         787.4 (31.0)      787.4 (31.0)      787.4 (31.0)      787.4 (31.0)
   BLOWER INLET P MM. H2O(IN. H2O)       774.7 (30.5)      774.7 (30.5)      774.7 (30.5)      774.7 (30.5)
   BLOWER INLET TEMP. DEG. C(DEG. F)      43.3 (110.0)      43.3 (110.0)      43.3 (110.0)      43.3 (110.0)
   BLOWER REVOLUTIONS                       40773             70518             40824             70710
   CVS FLOW STD. CU. METRES(SCF)          75.8 (2677.9)    131.2 (4633.0)     75.9 (2681.5)    131.5 (4646.0)
   HC  SAMPLE METER/RANGE/PPM            40.9/ 2/   41     11.9/ 2/   12     15.0/ 2/   15     11.3/ 2/   11
   HC  BCKGRD METER/RANGE/PPM             8.6/ 2/    9      8.7/ 2/    9      8.5/ 2/    9      9.0/ 2/    9
   CO  SAMPLE METER/RANGE/PPM            61.1/11/  246      5.4/13/    5     14.6/13/   14      4.0/13/    4
   CO  BCKGRD METER/RANGE/PPM             1.3/11/    4      2.8/13/    3      1.5/13/    1      1.4/13/    1
   CO2 SAMPLE METER/RANGE/PCT            84.1/ 3/ 1.55     56.8/ 3/ 1.00     76.4/ 3/ 1.40     58.3/ 3/ 1.03
   CO2 BCKGRD METER/RANGE/PCT             3.8/ 3/  .06      4.2/ 3/  .06      4.0/ 3/  .06      4.2/ 3/  .06
   NOX SAMPLE METER/RANGE/PPM            41.7/ 3/  125     51.8/ 2/   52     36.5/ 3/  109     47.4/ 2/   47
   NOX BCKGRD METER/RANGE/PPM              .6/ 3/    2      2.0/ 2/    2       .4/ 3/    1      1.7/ 2/    2
   DILUTION FACTOR                            8.47             13.38              9.58             13.00

   HC  CONCENTRATION PPM                       33                 4                 7                 3
   CO  CONCENTRATION PPM                      231                 3                12                 3
   CO2 CONCENTRATION PCT                     1.50               .94              1.34               .97
   NOX CONCENTRATION PPM                    123.5              49.9             108.4              45.8
   HC  MASS GRAMS                            1.46               .29               .32               .23
   CO  MASS GRAMS                           20.42               .39              1.07               .39
   CO2 MASS GRAMS                          2087.6            2258.0            1863.5            2336.0
   NOX MASS GRAMS                           17.64             12.34             15.50             11.36

   HC  GRAMS/KM                               .26               .05               .06               .04
   CO  GRAMS/KM                              3.58               .06               .19               .06
   CO2 GRAMS/KM                             365.7             365.9             325.4             384.0
   NOX GRAMS/KM                              3.09              2.00              2.71              1.87
   FUEL CONSUMPTION BY CB L/100KM           15.88             15.63             13.91             16.40

   RUN TIME              SECONDS              505               867               505               868
   AVG. EXH. OXYGEN      PERCENT             3.85              3.93              3.56              3.45
   CATALYST AVG. TEMP.   DEG. C                -                 -                 -                 -
   CATALYST MAX. TEMP.   DEG. C                -                 -                 -                 -
   MEASURED DISTANCE     KM                  5.71              6.17              5.73              6.08
        DFC, WET (DRY)                             .909 ( .900)                        .913 ( .904)
        SCF, WET (DRY)                            1.000 ( .979)                       1.000 ( .979)
        VOL (SCM)                                        207.0                               207.5
        KM  (MEASURED)                                   11.88                               11.81

COMPOSITE RESULTS                                                                                    3-BAG      (4-BAG)
   TEST NUMBER             511-21     TOTAL FUEL SULFUR   MG/KM   32.59    CARBON DIOXIDE        G/KM     354.7     ( 360.0)
   BAROMETER     MM HG     737.6      AVG. EXH. OXYGEN    PCT      3.84    FUEL CONSUMPTION      L/100KM   15.21     ( 15.43)
   HUMIDITY      G/KG       10.2      CATALYST AVG. TEMP. DEG C      -     HYDROCARBONS (THC)    G/KM        .09     (   .09)
   TEMPERATURE   DEG C      24.4      CATALYST MAX. TEMP. DEG C      -     CARBON MONOXIDE       G/KM        .82     (   .82)
                                                                           OXIDES OF NITROGEN    G/KM       2.42     (  2.38)
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TABLE E-4. TEST NO. 511-22 EMISSIONS RESULTS

PVM - 511 SBT VEHICLE EMISSIONS RESULTS - DISABLED O2 SENSOR
PROJECT 11-5402-001

VEHICLE MODEL 79 MERCURY MARQUIS
ENGINE 5.7 L(351 CID) V-8

VEHICLE NO. 51
TRANSMISSION A3
GVW 2434 KG(5365 LBS)

TEST WEIGHT 2041 KG(4500 LBS)
ACTUAL ROAD LOAD 8.9 KW(12.0 HP)
GASOLINE EM-344

TEST NUMBER	511-22	511-23	
TEST CYCLE	SET	HFET	
RUN NUMBER	1	1	
DATE	4/26/79	4/26/79	/ /
ODOMETER	4076KM(2533MILES)	4085KM(2538MILES)	
CVS - BAG CART - DYNAMOMETER	2 - 1 - 3	2 - 1 - 3	
TEMPERATURE DEG. C (DEG. F)	24.4 / 76.0	28.3 / 83.0	
RELATIVE HUMIDITY, PCT	52.0	37.4	
BAROMETER, MM HG(IN HG)	738.1 (29.06)	738.9 (29.09)	
RUN TIME, SECONDS	1398	766	
BLOWER DIF P MM. H2O(IN. H2O)	787.4 (31.0)	787.4 (31.0)	
BLOWER INLET P MM. H2O(IN. H2O)	774.7 (30.5)	774.7 (30.5)	
BLOWER INLET TEMP. DEG. C(DEG. F)	43.3 (110.0)	43.3 (110.0)	
BLOWER REVOLUTIONS	112395	62448	
CVS FLOW STD. CU. METRES(SCF)	209.1 (7386.1)	116.4 (4111.3)	
HC SAMPLE METER/RANGE/PPM	14.0/ 2/ 14	10.3/ 2/ 10	
HC BCKGRD METER/RANGE/PPM	8.6/ 2/ 9	7.8/ 2/ 8	
CO SAMPLE METER/RANGE/PPM	25.0/13/ 24	9.3/13/ 9	
CO BCKGRD METER/RANGE/PPM	1.9/13/ 2	1.1/13/ 1	
CO2 SAMPLE METER/RANGE/PCT	83.7/ 3/ 1.55	94.5/ 3/ 1.77	
CO2 BCKGRD METER/RANGE/PCT	4.1/ 3/ .06	4.4/ 3/ .07	
NOX SAMPLE METER/RANGE/PPM	46.4/ 3/ 139	33.4/ 3/ 100	
NOX BCKGRD METER/RANGE/PPM	.8/ 3/ 2	.7/ 3/ 2	
HC CONCENTRATION PPM	6	4	
CO CONCENTRATION PPM	21	8	
CO2 CONCENTRATION PCT	1.49	1.71	
NOX CONCENTRATION PPM	137.1	98.4	
HC MASS GRAMS	.77	.24	
CO MASS GRAMS	5.11	1.04	
CO2 MASS GRAMS	5709.7	3653.8	
NOX MASS GRAMS	53.98	20.89	
DFC, WET (DRY)	.884 (.875)	.868 (.863)	
SCF, WET (DRY)	1.000 (.975)	1.000 (.978)	
VOL (SCM)	209.1	116.4	
KM (MEASURED)	21.46	16.12	

TEST NUMBER,	PVM-ST	511-22	511-23
BAROMETER,	MM HG	738.1	738.9
HUMIDITY,	G/KG	10.2	9.2
TEMPERATURE,	DEG C	24.4	28.3
TOTAL FUEL SULFUR,	MG/KM	24.38	20.75
AVG. EXH. OXYGEN,	PCT	3.86	1.31
CATALYST AVG. TEMP.,	DEG C	-	-
CATALYST MAX. TEMP.,	DEG C	-	-
CARBON DIOXIDE,	G/KM	266.0	226.7
FUEL CONSUMPTION,	L/100KM	11.38	9.68
HYDROCARBONS,	G/KM	.04	.01
CARBON MONOXIDE,	G/KM	.24	.06
OXIDES OF NITROGEN,	G/KM	2.52	1.30

TABLE E-5. TEST NO. 511-31 EMISSIONS RESULTS

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                         PVM - 511   FTP  VEHICLE EMISSIONS RESULTS - DISABLED O2 SENSOR
                                          PROJECT 11-5402-001

TEST NO.    511-31   RUN   1                VEHICLE NO.    51                           TEST WEIGHT   2041 KG(  4500 LBS)
VEHICLE MODEL    79 MERCURY MARQUIS         DATE    4/30/79                             ACTUAL ROAD LOAD   8.9 KW( 12.0 HP)
ENGINE 5.7 L(351 CID) V-8                   BAG CART NO.  1                             GASOLINE  EM-344
TRANSMISSION A3                             DYNO NO.      3                             ODOMETER   4113 KM(  2556 MILES)
GVW  2434 KG(  5365 LBS)                    CVS NO.       2

BAROMETER 742.70 MM HG(29.24 IN HG)         DRY BULB TEMP. 25.0 DEG C(77.0 DEG F)
RELATIVE HUMIDITY 52 PCT                    ABS. HUMIDITY 10.6 GM/KG                    NOX HUMIDITY CORRECTION FACTOR  1.00
BAG RESULTS
   BAG NUMBER                                      1                   2                   3                   4
   DESCRIPTION                              COLD TRANSIENT         STABILIZED         HOT TRANSIENT         STABILIZED

   BLOWER DIF P MM. H2O(IN. H2O)             787.4 (31.0)        787.4 (31.0)        787.4 (31.0)        787.4 (31.0)
   BLOWER INLET P MM. H2O(IN. H2O)           774.7 (30.5)        774.7 (30.5)        774.7 (30.5)        774.7 (30.5)
   BLOWER INLET TEMP. DEG. C(DEG. F)          43.3 (110.0)        43.3 (110.0)        43.3 (110.0)        43.3 (110.0)
   BLOWER REVOLUTIONS                            40748               69662               40564               69634
   CVS FLOW STD. CU. METRES(SCF)             76.3 (2696.6)      130.5 (4608.9)       76.0 (2683.9)      130.4 (4606.9)
   HC  SAMPLE METER/RANGE/PPM               48.6/ 2/   49       12.8/ 2/   13       18.2/ 2/   18       13.0/ 2/   13
   HC  BCKGRD METER/RANGE/PPM                8.1/ 2/    8        8.2/ 2/    8       10.5/ 2/   10        8.6/ 2/    9
   CO  SAMPLE METER/RANGE/PPM               76.7/11/  343        3.6/13/    4       12.6/13/   12        2.0/13/    2
   CO  BCKGRD METER/RANGE/PPM                1.3/11/    4        2.7/13/    3        1.0/13/    1         .9/13/    1
   CO2 SAMPLE METER/RANGE/PCT               85.5/ 3/ 1.58       57.7/ 3/ 1.02       80.5/ 3/ 1.48       59.2/ 3/ 1.05
   CO2 BCKGRD METER/RANGE/PCT                3.8/ 3/  .06        4.0/ 3/  .06        4.2/ 3/  .06        4.1/ 3/  .06
   NOX SAMPLE METER/RANGE/PPM               45.9/ 3/  138       52.3/ 2/   52       39.0/ 3/  117       50.3/ 2/   50
   NOX BCKGRD METER/RANGE/PPM                 .6/ 3/    2        1.7/ 2/    2         .4/ 3/    1        2.0/ 2/    2
   DILUTION FACTOR                               8.26               13.15                9.04               12.78

   HC  CONCENTRATION PPM                          41                   5                   9                   5
   CO  CONCENTRATION PPM                         323                   1                  11                   1
   CO2 CONCENTRATION PCT                        1.53                 .96                1.42                 .99
   NOX CONCENTRATION PPM                       136.1                50.7               115.9                48.5
   HC  MASS GRAMS                               1.83                 .39                 .39                 .38
   CO  MASS GRAMS                              28.72                 .15                 .95                 .17
   CO2 MASS GRAMS                             2143.3              2295.7              1979.8              2362.5
   NOX MASS GRAMS                              19.82               12.62               16.80               12.05

   HC  GRAMS/KM                                  .32                 .06                 .07                 .06
   CO  GRAMS/KM                                 5.01                 .02                 .17                 .03
   CO2 GRAMS/KM                                374.1               376.3               345.4               385.7
   NOX GRAMS/KM                                 3.46                2.07                2.93                1.97
   FUEL CONSUMPTION BY CB L/100KM              16.35               16.07               14.76               16.47

   RUN TIME                SECONDS               505                 868                 505                 868
   AVG. EXH. OXYGEN        PERCENT              3.99                3.58                3.44                3.38
   CATALYST AVG. TEMP.     DEG. C                471                 587                 558                 605
   CATALYST MAX. TEMP.     DEG. C                661                 614                 648                 658
   MEASURED DISTANCE       KM                   5.73                6.10                5.73                6.12
         DFC, WET (DRY)                                .907 ( .898)                            .910 ( .900)
         SCF, WET (DRY)                               1.000 ( .978)                           1.000 ( .978)
         VOL (SCM)                                          206.8                                   206.4
         KM  (MEASURED)                                     11.83                                   11.86

COMPOSITE RESULTS                                                                                 3-BAG        (4-BAG)
   TEST NUMBER            511-31      TOTAL FUEL SULFUR    MG/KM   33.79     CARBON DIOXIDE       G/KM      367.3      ( 370.1)
   BAROMETER     MM HG   742.7        AVG. EXH. OXYGEN     PCT      3.61     FUEL CONSUMPTION     L/100KM    15.77      ( 15.89)
   HUMIDITY      G/KG     10.6        CATALYST AVG. TEMP. DEG C     562     HYDROCARBONS (THC)   G/KM         .12      (   .12)
   TEMPERATURE   DEG C    25.0        CATALYST MAX. TEMP. DEG C     661     CARBON MONOXIDE      G/KM        1.10      (  1.10)
                                                                            OXIDES OF NITROGEN   G/KM        2.60      (  2.57)
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TABLE E-6. TEST NO. 511-32 EMISSIONS RESULTS

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                           PVM - 511   SBT  VEHICLE EMISSIONS RESULTS - DISABLED O2 SENSOR
                                            PROJECT 11-5402-001

VEHICLE MODEL    79 MERCURY MARQUIS        VEHICLE NO.       51                   TEST WEIGHT    2041 KG(  4500 LBS)
ENGINE 5.7 L(351 CID) V-8                  TRANSMISSION A3                        ACTUAL ROAD LOAD     8.9 KW( 12.0 HP)
                                           GVW  2434 KG(  5365 LBS)               GASOLINE  EM-344

  TEST NUMBER                                  511-32                511-33
  TEST CYCLE                                    SET                   HFET
  RUN NUMBER                                     1                     1
  DATE                                        4/30/79               4/30/79                 / /
  ODOMETER                              4142KM(  2574MILES)   4160KM(  2585MILES)
  CVS - BAG CART - DYNAMOMETER               2 - 1 - 3             2 - 1 - 3

  TEMPERATURE DEG. C (DEG. F)              26.7 / 80.0           26.7 / 80.0
  RELATIVE HUMIDITY, PCT                       50.8                  47.5
  BAROMETER, MM HG(IN HG)                 742.7 (29.24)         742.7 (29.24)
  RUN TIME, SECONDS                            1398                  766

  BLOWER DIF P MM. H2O(IN. H2O)           787.4 (31.0)          787.4 (31.0)
  BLOWER INLET P MM. H2O(IN. H2O)         774.7 (30.5)          774.7 (30.5)
  BLOWER INLET TEMP. DEG. C(DEG. F)        43.3 (110.0)          43.3 (110.0)
  BLOWER REVOLUTIONS                         112165                61503
  CVS FLOW STD. CU. METRES(SCF)          210.1 (7420.8)        115.2 (4069.1)
  HC   SAMPLE METER/RANGE/PPM            14.4/ 2/   14          9.7/ 2/   10
  HC   BCKGRD METER/RANGE/PPM             8.3/ 2/    8          7.5/ 2/    8
  CO   SAMPLE METER/RANGE/PPM            23.3/13/   22          5.4/13/    5
  CO   BCKGRD METER/RANGE/PPM             2.0/13/    2           .1/13/    0
  CO2  SAMPLE METER/RANGE/PCT            86.9/ 3/ 1.61         97.1/ 3/ 1.83
  CO2  BCKGRD METER/RANGE/PCT             4.3/ 3/  .07          3.8/ 3/  .06
  NOX  SAMPLE METER/RANGE/PPM            51.0/ 3/  153         31.1/ 3/   93
  NOX  BCKGRD METER/RANGE/PPM              .7/ 3/    2           .6/ 3/    2
  HC   CONCENTRATION PPM                       7                     3
  CO   CONCENTRATION PPM                      19                     5
  CO2  CONCENTRATION PCT                     1.56                  1.78
  NOX  CONCENTRATION PPM                    151.2                  91.7
  HC   MASS GRAMS                             .86                   .21
  CO   MASS GRAMS                            4.74                   .66
  CO2  MASS GRAMS                          5984.2                3749.3
  NOX  MASS GRAMS                           62.06                 20.15
       DFC, WET (DRY)                  .879 ( .871)          .864 ( .856)
       SCF, WET (DRY)                 1.000 ( .975)         1.000 ( .974)
       VOL (SCM)                            210.1                 115.2
       KM  (MEASURED)                       21.51                 16.16

  TEST NUMBER,           PVM-ST            511-32                511-33
  BAROMETER,             MM HG              742.7                 742.7
  HUMIDITY,              G/KG                11.4                  10.6
  TEMPERATURE,           DEG C               26.7                  26.7
  TOTAL FUEL SULFUR,     MG/KM              25.49                 21.23

  AVG. EXH. OXYGEN,      PCT                 3.92                  1.38
  CATALYST AVG. TEMP.,   DEG C                617                   606
  CATALYST MAX. TEMP.,   DEG C                715                   636
  CARBON DIOXIDE,        G/KM               278.2                 232.0
  FUEL CONSUMPTION,      L/100KM            11.89                  9.41

  HYDROCARBONS,          G/KM                 .04                   .01
  CARBON MONOXIDE,       G/KM                 .22                   .04
  OXIDES OF NITROGEN,    G/KM                2.88                  1.25
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TABLE E-7. TEST NO. 511-12 EMISSIONS RESULTS

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                        PVM - 512   FTP  VEHICLE EMISSIONS RESULTS - UNMODIFIED
                                         PROJECT 11-5402-001

TEST NO.   512-11   RUN   1                  VEHICLE NO.   51                 TEST WEIGHT   2041 KG(  4500 LBS)
VEHICLE MODEL   79 MERCURY MARQUIS           DATE    6/14/79                  ACTUAL ROAD LOAD   8.9 KW( 12.0 HP)
ENGINE 5.7 L(351 CID) V-8                    BAG CART NO.  1                  GASOLINE  EM-344
TRANSMISSION A3                              DYNO NO.      3                  ODOMETER  10926 KM(  6789 MILES)
GVW  2434 KG(  5365 LBS)                     CVS NO.       2

BAROMETER 744.73 MM HG(29.32 IN HG)          DRY BULB TEMP. 24.4 DEG C(76.0 DEG F)
RELATIVE HUMIDITY 45 PCT                     ABS. HUMIDITY  8.7 GM/KG         NOX HUMIDITY CORRECTION FACTOR   .94
BAG RESULTS
   BAG NUMBER                                    1                  2                  3                  4
   DESCRIPTION                             COLD TRANSIENT      STABILIZED        HOT TRANSIENT       STABILIZED

   BLOWER DIF P MM. H2O(IN. H2O)           838.2 (33.0)       838.2 (33.0)       838.2 (33.0)       812.8 (32.0)
   BLOWER INLET P MM. H2O(IN. H2O)         812.8 (32.0)       812.8 (32.0)       812.8 (32.0)       787.4 (31.0)
   BLOWER INLET TEMP. DEG. C(DEG. F)        43.3 (110.0)       43.9 (111.0)       43.3 (110.0)       43.3 (110.0)
   BLOWER REVOLUTIONS                         40542              69614              40518              69628
   CVS FLOW STD. CU. METRES(SCF)            75.7 (2674.8)     129.9 (4587.9)      75.7 (2673.0)     130.5 (4609.9)
   HC   SAMPLE METER/RANGE/PPM             46.6/ 2/   47      16.6/ 2/   17      20.3/ 2/   20      13.1/ 2/   13
   HC   BCKGRD METER/RANGE/PPM              7.5/ 2/    8       8.1/ 2/    8       9.6/ 2/   10       9.2/ 2/    9
   CO   SAMPLE METER/RANGE/PPM             81.9/11/  380      29.2/13/   28      52.2/13/   50      13.6/13/   13
   CO   BCKGRD METER/RANGE/PPM               .8/11/    2       1.1/13/    1       1.0/13/    1        .9/13/    1
   CO2  SAMPLE METER/RANGE/PCT             79.0/ 3/ 1.45      60.0/ 3/ 1.06      79.3/ 3/ 1.46      57.8/ 3/ 1.02
   CO2  BCKGRD METER/RANGE/PCT              4.6/ 3/  .07       4.1/ 3/  .06       3.8/ 3/  .06       3.3/ 3/  .05
   NOX  SAMPLE METER/RANGE/PPM             57.8/ 2/   58      19.7/ 2/   20      46.7/ 2/   47      20.6/ 2/   21
   NOX  BCKGRD METER/RANGE/PPM              1.8/ 2/    2       1.7/ 2/    2       1.7/ 2/    2       1.7/ 2/    2
   DILUTION FACTOR                              8.99              12.56               9.17              13.11

   HC   CONCENTRATION PPM                        40                  9                 12                  5
   CO   CONCENTRATION PPM                       362                 26                 47                 12
   CO2  CONCENTRATION PCT                      1.39               1.01               1.40                .97
   NOX  CONCENTRATION PPM                      56.2               18.1               45.2               19.0
   HC   MASS GRAMS                             1.74                .69                .51                .35
   CO   MASS GRAMS                            31.91               3.89               4.13               1.79
   CO2  MASS GRAMS                           1922.4             2390.8             1944.8             2324.9
   NOX  MASS GRAMS                             7.65               4.23               6.14               4.46

   HC   GRAMS/KM                                .30                .11                .09                .06
   CO   GRAMS/KM                               5.57                .63                .72                .29
   CO2  GRAMS/KM                              335.7              384.9              337.4              376.3
   NOX  GRAMS/KM                               1.34                .68               1.07                .72
   FUEL CONSUMPTION BY CB L/100KM             14.74              16.48              14.46              16.09

   RUN TIME                SECONDS              504                868                505                868
   AVG. EXH. OXYGEN        PERCENT             4.73               4.67               4.86               4.44
   CATALYST AVG. TEMP.     DEG. C               442                513                463                503
   CATALYST MAX. TEMP.     DEG. C               572                559                525                550
   MEASURED DISTANCE       KM                  5.73               6.21               5.76               6.18
         DFC, WET (DRY)                               .909 ( .901)                          .912 ( .904)
         SCF, WET (DRY)                              1.000 ( .981)                         1.000 ( .981)
         VOL (SCM)                                           205.6                                 206.2
         KM  (MEASURED)                                      11.94                                 11.94

                                                                                                3-BAG        (4-BAG)
COMPOSITE RESULTS
  TEST NUMBER            512-11    TOTAL FUEL SULFUR    MG/KM   33.37    CARBON DIOXIDE       G/KM      361.7      ( 359.1)
  BAROMETER    MM HG      744.7    AVG. EXH. OXYGEN     PCT      4.72    FUEL CONSUMPTION     L/100KM    15.57     ( 15.45)
  HUMIDITY     G/KG         8.7    CATALYST AVG. TEMP.  DEG C     491    HYDROCARBONS (THC)   G/KM        .14      (   .13)
  TEMPERATURE  DEG C       24.4    CATALYST MAX. TEMP.  DEG C     572    CARBON MONOXIDE      G/KM       1.67      (  1.57)
                                                                         OXIDES OF NITROGEN   G/KM        .92      (   .93)
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TABLE E-8. TEST NO. 512-12 EMISSIONS RESULTS

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                    PVM - 512   SBT  VEHICLE EMISSIONS RESULTS - UNMODIFIED
                                     PROJECT 11-5402-001

                                          VEHICLE NO.     51                   TEST WEIGHT   2041 KG(  4500 LBS)
VEHICLE MODEL   79 MERCURY MARUUIS        TRANSMISSION A3                      ACTUAL ROAD LOAD   8.9 KW( 12.0 HP)
ENGINF 5.7 L(351 CID) V-8                 GVW  2434 KG(  5365 LBS)             GASOLINE  EM-344

   TEST NUMBER                              512-12              512-13
   TEST CYCLE                                SET                 HFET
   RUN NUMBER                                 1                   1
   DATE                                    6/14/79             6/14/79                 /  /
   ODOMETER                           10968KM(  6815MILES)  11010KM(  6841MILES)
   CVS - BAG CART - DYNAMOMETER             2 - 1 - 3           2 - 1 - 3

   TEMPERATURE DEG. C (DEG. F)            26.7 / 80.0         27.2 / 81.0
   RELATIVE HUMIDITY, PCT                   47.5                51.3
   BAROMETER, MM HG(IN HG)               744.2 (29.30)       744.7 (29.32)
   RUN TIME, SECONDS                        1397                766

   BLOWER DIF P MM. H2O(IN. H2O)         838.2 (33.0)        838.2 (33.0)
   BLOWER INLET P MM. H2O(IN. H2O)       812.8 (32.0)        812.8 (32.0)
   BLOWER INLET TEMP. DEG. C(DEG. F)      43.3 (110.0)        43.9 (111.0)
   BLOWER REVOLUTIONS                      111947              61374
   CVS FLOW STD. CU. METRES(SCF)        208.9 (7379.1)      114.5 (4044.7)
   HC   SAMPLE METER/RANGE/PPM           17.4/ 2/   17       10.7/ 2/   11
   HC   BCKGRD METER/RANGE/PPM           13.0/ 2/   13        9.3/ 2/    9
   CO   SAMPLE METER/RANGE/PPM           43.2/13/   41        4.6/13/    4
   CO   BCKGRD METER/RANGE/PPM            1.8/13/    2         .4/13/    0
   CO2  SAMPLE METER/RANGE/PCT           85.9/ 3/ 1.59       43.9/ 2/ 1.95
   CO2  BCKGRD METER/RANGE/PCT            3.4/ 3/  .05        1.3/ 2/  .05
   NOX  SAMPLE METER/RANGE/PPM           47.4/ 2/   47       69.1/ 2/   69
   NOX  BCKGRD METER/RANGE/PPM            2.1/ 2/    2        1.9/ 2/    2
   HC   CONCENTRATION PPM                     6                   3
   CO   CONCENTRATION PPM                    38                   4
   CO2  CONCENTRATION PCT                   1.55                1.91
   NOX  CONCENTRATION PPM                   45.6                67.5
   HC   MASS GRAMS                           .72                 .18
   CO   MASS GRAMS                          9.14                 .52
   CO2  MASS GRAMS                        5917.3              3996.3
   NOX  MASS GRAMS                         18.13               15.34
        DFC, WET (DRY)                  .881 ( .873)        .855 ( .846)
        SCF, WET (DRY)                 1.000 ( .976)       1.000 ( .972)
        VOL (SCM)                          208.9               114.5
        KM  (MEASURED)                     21.38               16.22

   TEST NUMBER,            PVM-ST          512-12              512-13
   BAROMETER,              MM HG           744.2               744.7
   HUMIDITY,               G/KG             10.6                11.8
   TEMPERATURE,            DEG C            26.7                27.2
   TOTAL FUEL SULFUR,      MG/KM            25.38               22.54

   AVG. EXH. OXYGEN,       PCT              3.96                3.39
   CATALYST AVG. TEMP.,    DEG C             564                 594
   CATALYST MAX. TEMP.,    DEG C             610                 618
   CARBON DIOXIDE,         G/KM            276.7               246.3
   FUEL CONSUMPTION,       L/100KM          11.84               10.52

   HYDROCARBONS,           G/KM              .03                 .01
   CARBON MONOXIDE,        G/KM              .43                 .03
   OXIDES OF NITROGEN,     G/KM              .85                 .95
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TABLE E-9. TEST NO. 512-21 EMISSIONS RESULTS

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                              PVM - 512   FTP  VEHICLE EMISSIONS RESULTS - 12 PCT MISS W/O AIR
                                                  PROJECT 11-5402-001

TEST NO.   512-21   RUN   1                         VEHICLE NO.   51                    TEST WEIGHT   2041 KG(  4500 LBS)
VEHICLE MODEL   79 MERCURY MARQUIS                  DATE     6/21/79                    ACTUAL ROAD LOAD   8.9 KW( 12.0 HP)
ENGINE 5.7 L(351 CID) V-8                           BAG CART NO.  1                     GASOLINE  EM-344
TRANSMISSION A3                                     DYNO NO.      3                     ODOMETER  10118 KM(  6287 MILES)
GVW  2434 KG(  5365 LBS)                            CVS NO.       2

BAROMETER 744.22 MM HG(29.30 IN HG)                 DRY BULB TEMP. 23.9 DEG C(75.0 DEG F)
RELATIVE HUMIDITY 62 PCT                            ABS. HUMIDITY 11.8 GM/KG                NOX HUMIDITY CORRECTION FACTOR  1.04
BAG RESULTS
  BAG NUMBER                                             1                  2                  3                  4
  DESCRIPTION                                     COLD TRANSIENT       STABILIZED        HOT TRANSIENT       STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)                    914.4 (36.0)       914.4 (36.0)       914.4 (36.0)       914.4 (36.0)
  BLOWER INLET P MM. H2O(IN. H2O)                  889.0 (35.0)       889.0 (35.0)       889.0 (35.0)       889.0 (35.0)
  BLOWER INLET TEMP. DEG. C(DEG. F)                 43.9 (111.0)       43.9 (111.0)       43.9 (111.0)       43.9 (111.0)
  BLOWER REVOLUTIONS                                   40528              69441              40422              69395
  CVS FLOW STD. CU. METRES(SCF)                     74.7 (2640.1)     128.1 (4522.7)      74.5 (2632.8)     128.0 (4519.6)
  HC   SAMPLE METER/RANGE/PPM                     62.8/ 3/  628      82.9/ 2/   83      23.9/ 3/  239      70.0/ 2/   70
  HC   BCKGRD METER/RANGE/PPM                      2.0/ 3/   20      15.1/ 2/   15       1.5/ 3/   15      11.2/ 2/   11
  CO   SAMPLE METER/RANGE/PPM                     51.1/ 3/ 1254      66.6/11/  278      97.6/11/  515      64.7/11/  267
  CO   BCKGRD METER/RANGE/PPM                       .4/ 3/    9       2.1/11/    6       3.3/11/   10       2.2/11/    7
  CO2 SAMPLE METER/RANGE/PCT                      88.4/ 3/ 1.64      60.7/ 3/ 1.08      82.3/ 3/ 1.52      57.8/ 3/ 1.02
  CO2 BCKGRD METER/RANGE/PCT                       4.5/ 3/  .07       4.2/ 3/  .06       5.1/ 3/  .08       3.4/ 3/  .06
  NOX SAMPLE METER/RANGE/PPM                      39.7/ 2/   40      14.5/ 2/   14      20.2/ 2/   20      14.7/ 2/   15
  NOX BCKGRD METER/RANGE/PPM                       2.1/ 2/    2       1.8/ 2/    2        .9/ 2/    1        .5/ 2/    1
  DILUTION FACTOR                                      7.34              12.05               8.43              12.74

  HC   CONCENTRATION PPM                               611                69                226                 60
  CO   CONCENTRATION PPM                              1181               261                481                250
  CO2 CONCENTRATION PCT                               1.58              1.02               1.45                .96
  NOX CONCENTRATION PPM                               37.9              12.8               19.4               14.2
  HC   MASS GRAMS                                    26.33              5.10               9.71               4.40
  CO   MASS GRAMS                                   102.81             38.88              41.75              37.25
  CO2 MASS GRAMS                                    2169.6            2386.6             1976.9             2254.6
  NOX MASS GRAMS                                      5.62              3.26               2.87               3.61

  HC   GRAMS/KM                                       4.51               .82               1.67                .70
  CO   GRAMS/KM                                      17.60              6.24               7.17               5.95
  CO2 GRAMS/KM                                       371.5             383.3              339.8              361.2
  NOX GRAMS/KM                                         .96               .52                .49                .58
  FUEL CONSUMPTION BY CB L/100KM                     17.65             16.89              15.21              15.91

  RUN TIME                  SECONDS                    505               868                505                868
  AVG. EXH. OXYGEN          PERCENT                   2.08               .78                .75                .95
  CATALYST AVG. TEMP.       DEG. C                     505               654                614                654
  CATALYST MAX. TEMP.       DEG. C                     713               665                726                678
  MEASURED DISTANCE         KM                        5.84              6.23               5.82               6.26
       DFC, WET (DRY)                                       .892 ( .885)                          .907 ( .894)
       SCF, WET (DRY)                                      1.000 ( .974)                         1.000 ( .975)
       VOL (SCM)                                                  202.8                                 202.5
       KM  (MEASURED)                                             12.07                                 12.07

COMPOSITE RESULTS                                                                                         3-BAG         (4-BAG)
  TEST NUMBER                512-21     TOTAL FUEL SULFUR   MG/KM    35.54    CARBON DIOXIDE     G/KM      368.9        ( 362.4)
  BAROMETER       MM HG      744.2      AVG. EXH. OXYGEN    PCT        .98    FUEL CONSUMPTION   L/100KM    16.58        ( 16.30)
  HUMIDITY        G/KG        11.8      CATALYST AVG. TEMP. DEG C      622    HYDROCARBONS (THC) G/KM       1.82        (  1.79)
  TEMPERATURE     DEG C       23.9      CATALYST MAX. TEMP. DEG C      726    CARBON MONOXIDE    G/KM       6.86        (  8.78)
                                                                              OXIDES OF NITROGEN G/KM        .61        (   .62)
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TABLE E-10. TEST NO. 512-22 EMISSIONS RESULTS

PVM - 512 SBT VEHICLE EMISSIONS RESULTS - 12 PCT MISS W/O AIR
PROJECT 11-5402-001

VEHICLE MODEL 79 MERCURY MARQUIS
ENGINE 5.7 L(351 CID) V-8

VEHICLE NO. 51
TRANSMISSION A3
GVW 2434 KG(5365 LBS)

TEST WEIGHT 2041 KG(4500 LBS)
ACTUAL ROAD LOAD 8.9 KW(12.0 HP)
GASOLINE EM-344

TEST NUMBER	512-22	512-23	
TEST CYCLE	SET	HFET	
RUN NUMBER	1	1	
DATE	6/21/79	6/21/79	/ /
ODOMETER	10144KM(6303MILES)	10177KM(6324MILES)	
CVS - BAG CART - DYNAMOMETER	2 - 1 - 3	2 - 1 - 3	
TEMPERATURE DEG. C (DEG. F)	24.4 / 76.0	23.9 / 75.0	
RELATIVE HUMIDITY, PCT	55.4	58.6	
BAROMETER, MM HG(IN HG)	744.2 (29.30)	744.2 (29.30)	
RUN TIME, SECONDS	1397	766	
BLOWER DIF P MM. H2O(IN. H2O)	914.4 (36.0)	914.4 (36.0)	
BLOWER INLET P MM. H2O(IN. H2O)	889.0 (35.0)	889.0 (35.0)	
BLOWER INLET TEMP. DEG. C(DEG. F)	44.4 (112.0)	44.4 (112.0)	
BLOWER REVOLUTIONS	111619	61270	
CVS FLOW STD. CU. METRES(SCF)	205.6 (7262.6)	112.9 (3986.7)	
HC SAMPLE METER/RANGE/PPM	71.0/ 2/ 71	33.2/ 2/ 33	
HC BCKGRD METER/RANGE/PPM	13.3/ 2/ 13	12.5/ 2/ 13	
CO SAMPLE METER/RANGE/PPM	63.6/11/ 260	57.7/12/ 128	
CO BCKGRD METER/RANGE/PPM	2.0/11/ 6	2.6/12/ 5	
CO2 SAMPLE METER/RANGE/PCT	89.0/ 3/ 1.66	45.8/ 2/ 2.05	
CO2 BCKGRD METER/RANGE/PCT	4.8/ 3/ .07	2.1/ 2/ .08	
NOX SAMPLE METER/RANGE/PPM	26.0/ 2/ 26	36.1/ 2/ 36	
NOX BCKGRD METER/RANGE/PPM	.9/ 2/ 1	1.0/ 2/ 1	
HC CONCENTRATION PPM	59	23	
CO CONCENTRATION PPM	242	117	
CO2 CONCENTRATION PCT	1.59	1.98	
NOX CONCENTRATION PPM	25.2	35.3	
HC MASS GRAMS	7.04	1.47	
CO MASS GRAMS	57.97	15.40	
CO2 MASS GRAMS	5997.7	4101.8	
NOX MASS GRAMS	9.96	7.20	
DFC, WET (DRY)	.874 (.864)	.846 (.835)	
SCF, WET (DRY)	1.000 (.973)	1.000 (.969)	
VOL (SCM)	205.6	112.9	
KM (MEASURED)	21.70	16.43	

TEST NUMBER,	PVM-ST	512-22	512-23
BAROMETER,	MM HG	744.2	744.2
HUMIDITY,	G/KG	10.8	11.1
TEMPERATURE,	DEG C	24.4	23.9
TOTAL FUEL SULFUR,	MG/KM	25.76	23.00
AVG. EXH. OXYGEN,	PCT	.63	.29
CATALYST AVG. TEMP.,	DEG C	728	778
CATALYST MAX. TEMP.,	DEG C	787	791
CARBON DIOXIDE,	G/KM	276.4	249.7
FUEL CONSUMPTION,	L/100KM	12.02	10.73
HYDROCARBONS,	G/KM	.32	.09
CARBON MONOXIDE,	G/KM	2.67	.94
OXIDES OF NITROGEN,	G/KM	.46	.47

TABLE E-11. TEST NO. 512-31 EMISSIONS RESULTS

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                    PVM - 512   FTP  VEHICLE EMISSIONS RESULTS - 12 PCT MISS W/O AIR
                                           PROJECT 11-5402-001

TEST NO.   512-31   RUN   1                  VEHICLE NO.   51                      TEST WEIGHT    2041 KG(  4500 LBS)
VEHICLE MODEL   79 MERCURY MARQUIS           DATE    6/22/79                       ACTUAL ROAD LOAD    8.9 KW( 12.0 HP)
ENGINE 5.7 L(351 CID) V-8                    BAG CART NO.  1                       GASOLINE  EM-344
TRANSMISSION A3                              DYNO NO.      3                       ODOMETER  10195 KM(  6335 MILES)
GVW  2434 KG(  5365 LBS)                     CVS NO.       2

BAROMETER 743.46 MM HG(29.27 IN HG)          DRY BULB TEMP. 23.3 DEG C(74.0 DEG F)
RELATIVE HUMIDITY 62 PCT                     ABS. HUMIDITY 11.3 GM/KG              NOX HUMIDITY CORRECTION FACTOR  1.02
BAG RESULTS
   BAG NUMBER                                      1                   2                  3                   4
   DESCRIPTION                              COLD TRANSIENT        STABILIZED        HOT TRANSIENT        STABILIZED

   BLOWER DIF P MM. H2O(IN. H2O)            901.7 (35.5)        901.7 (35.5)       901.7 (35.5)       901.7 (35.5)
   BLOWER INLET P MM. H2O(IN. H2O)          876.3 (34.5)        876.3 (34.5)       876.3 (34.5)       876.3 (34.5)
   BLOWER INLET TEMP. DEG. C(DEG. F)         43.3 (110.0)        43.9 (111.0)       43.9 (1'1.0)       43.9 (111.0)
   BLOWER REVOLUTIONS                           40598               71145              40385              69422
   CVS FLOW STD. CU. METRES(SCF)            75.0 (2649.2)      131.4 (4642.6)      74.5 (2632.2)     128.1 (4524.4)
   HC  SAMPLE METER/RANGE/PPM               52.4/ 3/  524      97.2/ 2/   97      28.7/ 3/  287      93.0/ 2/   93
   HC  BCKGRD METER/RANGE/PPM                4.2/ 3/   42      43.2/ 2/   43       4.5/ 3/   45      38.7/ 2/   39
   CO  SAMPLE METER/RANGE/PPM               42.3/ 3/ 1015      67.3/11/  282      28.1/ 3/  655      68.2/11/  287
   CO  BCKGRD METER/RANGE/PPM                 .3/ 3/    7       2.2/11/    7        .1/ 3/    2       3.3/11/   10
   CO2 SAMPLE METER/RANGE/PCT               84.4/ 3/ 1.56      59.0/ 3/ 1.04      80.4/ 3/ 1.48      57.6/ 3/ 1.02
   CO2 BCKGRD METER/RANGE/PCT                5.2/ 3/  .08       4.6/ 3/  .07       4.9/ 3/  .08       4.9/ 3/  .08
   NOX SAMPLE METER/RANGE/PPM               44.4/ 2/   44      15.2/ 2/   15      18.4/ 2/   18      14.3/ 2/   14
   NOX BCKGRD METER/RANGE/PPM                3.0/ 2/    3       3.0/ 2/    3       3.1/ 2/    3       2.8/ 2/    3
   DILUTION FACTOR                               7.84               12.41               8.54              12.73

   HC  CONCENTRATION PPM                         487                 57                 247                 57
   CO  CONCENTRATION PPM                         958                265                 621                267
   CO2 CONCENTRATION PCT                        1.49                .98                1.41                .95
   NOX CONCENTRATION PPM                        41.8               12.4                15.7                11.7
   HC  MASS GRAMS                              21.08               4.36               10.63                4.24
   CO  MASS GRAMS                              83.69              40.51               53.88               39.82
   CO2 MASS GRAMS                             2048.4             2354.4              1926.3              2219.1
   NOX MASS GRAMS                               6.12               3.19                2.28                2.93

   HC  GRAMS/KM                                 3.65                .70                1.84                .68
   CO  GRAMS/KM                                14.49               6.53                9.33                6.42
   CO2 GRAMS/KM                                354.7              379.4               333.5               357.8
   NOX GRAMS/KM                                 1.06                .51                 .39                .47
   FUEL CONSUMPTION BY CB L/100KM              16.61              16.73               15.11               15.79

   RUN TIME             SECONDS                  505                868                 504                868
   AVG. EXH. OXYGEN     PERCENT                 1.69                .84                 .73                .83
   CATALYST AVG. TEMP.  DEG. C                   477                643                 611                648
   CATALYST MAX. TEMP.  DEG. C                   687                657                 730                668
   MEASURED DISTANCE    KM                      5.77               6.21                5.78               6.20
        DFC, WET (DRY)                                  .902 ( .890)                           .907 ( .895)
        SCF, WET (DRY)                                 1.000 ( .975)                          1.000 ( .976)
        VOL (SCM)                                             206.4                                  202.6
        KM  (MEASURED)                                        11.98                                  11.98

COMPOSITE RESULTS                                                                                    3-BAG       (4-BAG)
   TEST NUMBER             512-31     TOTAL FUEL SULFUR    MG/KM    34.84    CARBON DIOXIDE      G/KM      361.7     ( 355.3)
   BAROMETER     MM HG     743.5      AVG. EXH. OXYGEN     PCT        .95    FUEL CONSUMPTION    L/100KM   16.26     ( 15.98)
   HUMIDITY      G/KG       11.3      CATALYST AVG. TEMP.  DEG C      610    HYDROCARBONS (THC)  G/KM       1.63     (  1.62)
   TEMPERATURE   DEG C      23.3      CATALYST MAX. TEMP.  DEG C      730    CARBON MONOXIDE     G/KM       8.95     (  8.92)
                                                                             OXIDES OF NITROGEN  G/KM        .59     (   .58)
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TABLE E-12. TEST NO. 512-32 EMISSIONS RESULTS

PVM - 512 SBT VEHICLE EMISSIONS RESULTS - 12 PCT MISS W/O AIR
PROJECT 11-5402-001

VEHICLE MODEL 79 MERCURY MARQUIS
ENGINE 5.7 L(351 CID) V-8

VEHICLE NO. 51
TRANSMISSION A3
GVW 2434 KG(5365 LBS)

TEST WEIGHT 2041 KG(4500 LBS)
ACTUAL ROAD LOAD 8.9 KW(12.0 HP)
GASOLINE EM-344

TEST NUMBER		512-32	512-33	
TEST CYCLE		SET	HFET	
RUN NUMBER		1	1	
DATE		6/21/79	6/21/79	/ /
ODOMETER		10223KM(6352MILES)	10094KM(6272MILES)	
CVS - BAG CART - DYNAMOMETER		2 - 1 - 3	2 - 1 - 3	
TEMPERATURE DEG. C (DEG. F)		25.6 / 78.0	25.6 / 78.0	
RELATIVE HUMIDITY, PCT		63.7	56.5	
BAROMETER, MM HG(IN HG)		743.5 (29.27)	743.5 (29.27)	
RUN TIME, SECONDS		1397	766	
BLOWER DIF P MM. H2O(IN. H2O)		901.7 (35.5)	800.1 (31.5)	
BLOWER INLET P MM. H2O(IN. H2O)		876.3 (34.5)	876.3 (34.5)	
BLOWER INLET TEMP. DEG. C(DEG. F)		44.4 (112.0)	44.4 (112.0)	
BLOWER REVOLUTIONS		111837	61981	
CVS FLOW STD. CU. METRES(SCF)		206.2 (7282.4)	114.7 (4051.8)	
HC SAMPLE METER/RANGE/PPM		90.5/ 2/ 90	40.4/ 2/ 40	
HC BCKGRD METER/RANGE/PPM		25.5/ 2/ 25	19.0/ 2/ 19	
CO SAMPLE METER/RANGE/PPM		71.8/11/ 310	63.7/12/ 143	
CO BCKGRD METER/RANGE/PPM		3.2/11/ 10	3.1/12/ 5	
CO2 SAMPLE METER/RANGE/PCT		86.0/ 3/ 1.59	45.0/ 2/ 2.01	
CO2 BCKGRD METER/RANGE/PCT		5.6/ 3/ .09	2.4/ 2/ .09	
NOX SAMPLE METER/RANGE/PPM		22.2/ 2/ 22	27.0/ 2/ 27	
NOX BCKGRD METER/RANGE/PPM		1.4/ 2/ 1	1.1/ 2/ 1	
HC CONCENTRATION PPM		68	24	
CO CONCENTRATION PPM		286	130	
CO2 CONCENTRATION PCT		1.52	1.93	
NOX CONCENTRATION PPM		21.0	26.1	
HC MASS GRAMS		8.10	1.61	
CO MASS GRAMS		68.59	17.39	
CO2 MASS GRAMS		5734.5	4057.1	
NOX MASS GRAMS		9.06	5.94	
DFC, WET (DRY)		.878 (.866)	.849 (.839)	
SCF, WET (DRY)		1.000 (.971)	1.000 (.970)	
VOL (SCM)		206.2	114.7	
KM (MEASURED)		21.59	16.36	
TEST NUMBER,	PVM-ST	512-32	512-33	
BAROMETER,	MM HG	743.5	743.5	
HUMIDITY,	G/KG	13.4	11.8	
TEMPERATURE,	DEG C	25.6	25.6	
TOTAL FUEL SULFUR,	MG/KM	24.86	22.86	
AVG. EXH. OXYGEN,	PCT	.53	.30	
CATALYST AVG. TEMP.,	DEG C	721	769	
CATALYST MAX. TEMP.,	DEG C	781	788	
CARBON DIOXIDE,	G/KM	265.6	248.0	
FUEL CONSUMPTION,	L/100KM	11.60	10.67	
HYDROCARBONS,	G/KM	.38	.10	
CARBON MONOXIDE,	G/KM	3.18	1.06	
OXIDES OF NITROGEN,	G/KM	.42	.36	

TABLE E-13. TEST NO. 513-11 EMISSIONS RESULTS

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                          PVM - 513   FTP  VEHICLE EMISSIONS RESULTS - UNMODIFIED
                                             PROJECT 11-5402-001

TEST NO.    513-11    RUN   1                  VEHICLE NO.    51                       TEST WEIGHT    2041 KG(  4500 LBS)
VEHICLE MODEL    79 MERCURY MARQUIS            DATE     5/28/79                        ACTUAL ROAD LOAD    8.9 KW( 12.0 HP)
ENGINE 5.7 L(351 CID) V-8                      BAG CART NO.  1                         GASOLINE  EM-344
TRANSMISSION A3                                DYNO NO.      3                         ODOMETER        0 KM(     -0 MILES)
GVW  2434 KG(  5365 LBS)                       CVS NO.       2

BAROMETER 738.89 MM HG(29.09 IN HG)            DRY BULB TEMP. 24.4 DEG C(76.0 DEG F)
RELATIVE HUMIDITY 52 PCT                       ABS. HUMIDITY 10.2 GM/KG                NOX HUMIDITY CORRECTION FACTOR    .98
BAG RESULTS
   BAG NUMBER                                      1                   2                      3                     4
   DESCRIPTION                              COLD TRANSIENT         STABILIZED          HOT TRANSIENT           STABILIZED

   BLOWER DIF P MM. H2O(IN. H2O)             825.5 (32.5)         838.2 (33.0)         825.5 (32.5)          825.5 (32.5)
   BLOWER INLET P MM. H2O(IN. H2O)           812.8 (32.0)         800.1 (31.5)         800.1 (31.5)          800.1 (31.5)
   BLOWER INLET TEMP. DEG. C(DEG. F)          43.3 (110.0)         43.3 (110.0)         43.3 (110.0)          43.3 (110.0)
   BLOWER REVOLUTIONS                           40586                69818                40538                 69516
   CVS FLOW STD. CU. METRES(SCF)              75.2 (2655.5)       129.5 (4572.3)        75.2 (2655.9)        128.9 (4554.0)
   HC  SAMPLE METER/RANGE/PPM                45.9/ 2/   46        14.6/ 2/   15        20.0/ 2/   20         14.6/ 2/   15
   HC  BCKGRD METER/RANGE/PPM                11.6/ 2/   12        10.5/ 2/   10        12.0/ 2/   12         11.1/ 2/   11
   CO  SAMPLE METER/RANGE/PPM                78.2/11/  353        36.2/13/   34        87.2/13/   88         33.1/13/   31
   CO  BCKGRD METER/RANGE/PPM                 1.7/11/    5         5.4/13/    5         7.2/13/    7          6.1/13/    6
   CO2 SAMPLE METER/RANGE/PCT                89.2/ 3/ 1.66        60.0/ 3/ 1.06        80.5/ 3/ 1.48         58.1/ 3/ 1.03
   CO2 BCKGRD METER/RANGE/PCT                 4.3/ 3/  .07         4.6/ 3/  .07         3.7/ 3/  .06          3.6/ 3/  .06
   NOX SAMPLE METER/RANGE/PPM                57.1/ 2/   57        15.1/ 2/   15        33.3/ 2/   33         14.8/ 2/   15
   NOX BCKGRD METER/RANGE/PPM                 1.6/ 2/    2         1.3/ 2/    1         1.1/ 2/    1          1.3/ 2/    1
   DILUTION FACTOR                               7.88                12.55                 8.99                 13.01

   HC  CONCENTRATION PPM                          36                    5                    9                     4
   CO  CONCENTRATION PPM                         331                   28                   77                    25
   CO2 CONCENTRATION PCT                        1.60                 1.00                 1.43                   .97
   NOX CONCENTRATION PPM                        55.7                 13.9                 32.3                  13.6
   HC  MASS GRAMS                               1.55                  .37                  .40                   .32
   CO  MASS GRAMS                              29.02                 4.25                 6.78                  3.72
   CO2 MASS GRAMS                             2208.2               2365.7               1968.7                2300.7
   NOX MASS GRAMS                               7.89                 3.39                 4.57                  3.30

   HC  GRAMS/KM                                  .27                  .06                  .07                   .05
   CO  GRAMS/KM                                 5.04                  .69                 1.18                   .61
   CO2 GRAMS/KM                                383.4                385.4                342.7                 375.3
   NOX GRAMS/KM                                 1.37                  .55                  .80                   .54
   FUEL CONSUMPTION BY CB L/100KM              16.74                16.50                14.71                 16.07

   RUN TIME                  SECONDS             505                  870                  505                   868
   AVG. EXH. OXYGEN          PERCENT              -                    -                    -                     -
   CATALYST AVG. TEMP.       DEG. C               -                    -                    -                     -
   CATALYST MAX. TEMP.       DEG. C               -                    -                    -                     -
   MEASURED DISTANCE         KM                 5.76                 6.14                 5.74                  6.13
        DFC, WET (DRY)                                   .903 ( .894)                             .910 ( .901)
        SCF, WET (DRY)                                  1.000 ( .978)                            1.000 ( .979)
        VOL (SCM)                                              204.6                                    204.1
        KM  (MEASURED)                                         11.40                                    11.87

COMPOSITE RESULTS                                                                                                3-BAG        (4-BAG)
  TEST NUMBER           513-11           TOTAL FUEL SULFUR    MG/KM    34.42      CARBON DIOXIDE        G/KM        373.2       ( 370.2)
  BAROMETER     MM HG   738.9            AVG. EXH. OXYGEN     PCT        -        FUEL CONSUMPTION      L/100KM      16.06       ( 15.93)
  HUMIDITY      G/KG     10.2            CATALYST AVG. TEMP. DEG C      -        HYDROCARBONS (THC)    G/KM          .11       (   .10)
  TEMPERATURE   DEG C    24.4            CATALYST MAX. TEMP. DEG C      -        CARBON MONOXIDE       G/KM         1.73       (  1.71)
                                                                                  OXIDES OF NITROGEN    G/KM          .79       (   .79)
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TABLE E-14. TEST NO. 513-12 EMISSIONS RESULTS

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                         PVM - 513   SBT  VEHICLE EMISSIONS RESULTS - UNMODIFIED
                                        PROJECT 11-5402-001

VEHICLE MODEL   79 MERCURY MARQUIS        VEHICLE NO.     51                         TEST WEIGHT   2041 KG(  4500 LBS)
ENGINE 5.7 L(351 CID) V-8                 TRANSMISSION A3                            ACTUAL ROAD LOAD   8.9 KW( 12.0 HP)
                                          GVW  2434 KG(  5365 LBS)                   GASOLINE  EM-344

  TEST NUMBER                                513-12                 513-13
  TEST CYCLE                                  SET                    HFET
  RUN NUMBER                                   1                      1
  DATE                                       5/28/79                5/28/79                 / /
  ODOMETER                                KM(       MILES)        KM(       MILES)
  CVS - BAG CART - DYNAMOMETER              2 - 1 - 3              2 - 1 - 3

  TEMPERATURE DEG. C (DEG. F)              25.6 / 78.0            25.6 / 78.0
  RELATIVE HUMIDITY, PCT                      43.1                   43.1
  BAROMETER, MM HG(IN HG)                 738.9 (29.09)          738.1 (29.06)
  RUN TIME, SECONDS                           1395                   767

  BLOWER DIF P MM. H2O(IN. H2O)           850.9 (33.5)           838.2 (33.0)
  BLOWER INLET P MM. H2O(IN. H2O)         812.8 (32.0)           812.8 (32.0)
  BLOWER INLET TEMP. DEG. C(DEG. F)        43.3 (110.0)           43.3 (110.0)
  BLOWER REVOLUTIONS                         111780                 61504
  CVS FLOW STD. CU. METRES(SCF)           206.9 (7306.2)         113.7 (4017.4)
  HC   SAMPLE METER/RANGE/PPM             18.2/ 2/    18         12.5/ 2/    13
  HC   BCKGRD METER/RANGE/PPM             15.0/ 2/    15         13.0/ 2/    13
  CO   SAMPLE METER/RANGE/PPM             49.6/13/    47         16.2/13/    15
  CO   BCKGRD METER/RANGE/PPM              2.3/13/     2          1.0/13/     1
  CO2  SAMPLE METER/RANGE/PCT             89.2/ 3/  1.66         45.0/ 2/  2.01
  CO2  BCKGRD METER/RANGE/PCT              4.4/ 3/   .07          1.7/ 2/   .06
  NOX  SAMPLE METER/RANGE/PPM             42.6/ 2/    43         63.2/ 2/    63
  NOX  BCKGRD METER/RANGE/PPM              1.4/ 2/     1          1.4/ 2/     1
  HC   CONCENTRATION PPM                       5                      1
  CO   CONCENTRATION PPM                      43                     14
  CO2  CONCENTRATION PCT                     1.60                   1.95
  NOX  CONCENTRATION PPM                     41.4                   62.0
  HC   MASS GRAMS                             .60                    .09
  CO   MASS GRAMS                           10.39                   1.84
  CO2  MASS GRAMS                          6069.8                 4067.7
  NOX  MASS GRAMS                           15.52                  12.79
       DFC, WET (DRY)                    .876 ( .869)           .850 ( .844)
       SCF, WET (DRY)                   1.000 ( .977)          1.000 ( .974)
       VOL (SCM)                            206.9                  113.7
       KM  (MEASURED)                       21.57                  16.41

  TEST NUMBER,          PVM-ST              513-12                 513-13
  BAROMETER,            MM HG                738.9                  738.1
  HUMIDITY,             G/KG                   9.0                    9.1
  TEMPERATURE,          DEG C                 25.6                   25.6
  TOTAL FUEL SULFUR,    MG/KM                25.81                  22.69

  AVG. EXH. OXYGEN,     PCT                    -                      -
  CATALYST AVG. TEMP.,  DEG C                  -                      -
  CATALYST MAX. TEMP.,  DEG C                  -                      -
  CARBON DIOXIDE,       G/KM                 281.3                  247.8
  FUEL CONSUMPTION,     L/100KM              12.04                  10.59

  HYDROCARBONS,         G/KM                   .03                    .01
  CARBON MONOXIDE,      G/KM                   .48                    .11
  OXIDES OF NITROGEN,   G/KM                   .72                    .78
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TABLE E-15. TEST NO. 513-21 EMISSIONS RESULTS

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                      PVM - 513   FTP  VEHICLE EMISSIONS RESULTS - DISABLED EGR AND AIR
                                       PROJECT 11-5402-001

TEST NO.   513-21    RUN   1                 VEHICLE NO.   51                  TEST WEIGHT   2041 KG(  4500 LBS)
VEHICLE MODEL   79 MERCURY MARQUIS           DATE     5/31/79                  ACTUAL ROAD LOAD   8.9 KW( 12.0 HP)
ENGINE 5.7 L(351 CID) V-8                    BAG CART NO.   1                  GASOLINE  EM-344
TRANSMISSION A3                              DYNO NO.       3                  ODOMETER    8874 KM(  5514 MILES)
GVW  2434 KG(  5365 LBS)                     CVS NO.        2

BAROMETER 739.90 MM HG(29.13 IN HG)          DRY BULB TEMP. 24.4 DEG C(76.0 DEG F)
RELATIVE HUMIDITY 56 PCT                     ABS. HUMIDITY 10.9 GM/KG              NOX HUMIDITY CORRECTION FACTOR  1.01
BAG RESULTS
  BAG NUMBER                                      1                  2                  3                  4
  DESCRIPTION                              COLD TRANSIENT       STABILIZED        HOT TRANSIENT       STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)            812.8 (32.0)       812.8 (32.0)       800.1 (31.5)       812.8 (32.0)
  BLOWER INLET P MM. H2O(IN. H2O)          787.4 (31.0)       787.4 (31.0)       774.7 (30.5)       787.4 (31.0)
  BLOWER INLET TEMP. DEG. C(DEG. F)         43.3 (110.0)       42.8 (109.0)       43.3 (110.0)       43.3 (110.0)
  BLOWER REVOLUTIONS                          40662              69476              40530              69442
  CVS FLOW STD. CU. METRES(SCF)             75.7 (2673.3)     129.4 (4571.3)      75.6 (2669.1)     129.2 (4564.4)
  HC  SAMPLE METER/RANGE/PPM               22.9/ 3/  229      16.4/ 3/  164      16.5/ 3/  165      14.4/ 3/  144
  HC  BCKGRD METER/RANGE/PPM                1.4/ 3/   14       1.5/ 3/   15       1.6/ 3/   16       1.4/ 3/   14
  CO  SAMPLE METER/RANGE/PPM               58.0/ 2/ 2912      73.1/ 3/ 1923      70.2/ 3/ 1828      58.2/ 3/ 1457
  CO  BCKGRD METER/RANGE/PPM                 .3/ 2/   11       2.0/ 3/   45       1.6/ 3/   36       1.4/ 3/   32
  CO2 SAMPLE METER/RANGE/PCT               83.5/ 3/ 1.54      55.6/ 3/  .98      74.4/ 3/ 1.35      55.5/ 3/  .97
  CO2 BCKGRD METER/RANGE/PCT                4.3/ 3/  .07       5.0/ 3/  .08       5.1/ 3/  .08       5.3/ 3/  .08
  NOX SAMPLE METER/RANGE/PPM               40.1/ 2/   40       8.5/ 2/    9      15.6/ 2/   16       7.3/ 2/    7
  NOX BCKGRD METER/RANGE/PPM                1.1/ 2/    1       1.1/ 2/    1       1.0/ 2/    1        .9/ 2/    1
  DILUTION FACTOR                              7.27              11.38               8.67              11.87

  HC  CONCENTRATION PPM                        217                150                151                131
  CO  CONCENTRATION PPM                       2764               1812               1716               1375
  CO2 CONCENTRATION PCT                       1.49                .91               1.28                .90
  NOX CONCENTRATION PPM                       39.2                7.5               14.7                6.5
  HC  MASS GRAMS                              9.47              11.22               6.57               9.78
  CO  MASS GRAMS                            243.60             273.15             151.03             206.99
  CO2 MASS GRAMS                            2058.9             2147.1             1777.9             2128.4
  NOX MASS GRAMS                              5.71               1.87               2.14               1.61

  HC  GRAMS/KM                                1.64               1.81               1.14               1.59
  CO  GRAMS/KM                               42.25              44.14              26.26              33.66
  CO2 GRAMS/KM                               357.1              346.9              309.1              346.1
  NOX GRAMS/KM                                 .99                .30                .37                .26
  FUEL CONSUMPTION BY CB L/100KM             18.30              18.01              15.11              17.24

  RUN TIME               SECONDS               505                867                505                867
  AVG. EXH. OXYGEN       PERCENT               .69                .40                .33                .38
  CATALYST AVG. TEMP.    DEG. C                328                422                392                424
  CATALYST MAX. TEMP.    DEG. C                440                436                466                440
  MEASURED DISTANCE      KM                   5.77               6.19               5.75               6.15
      DFC, WET (DRY)                                 .894 ( .884)                          .904 ( .894)
      SCF, WET (DRY)                                1.000 ( .978)                         1.000 ( .978)
      VOL (SCM)                                             205.1                                 204.8
      KM  (MEASURED)                                        11.96                                 11.90
COMPOSITE RESULTS                                                                                     3-BAG      (4-BAG)
  TEST NUMBER         513-21      TOTAL FUEL SULFUR    MG/KM   37.02    CARBON DIOXIDE       G/KM     338.6     ( 338.4)
  BAROMETER    MM HG  739.9       AVG. EXH. OXYGEN     PCT       .43    FUEL CONSUMPTION     L/100KM   17.27    ( 17.05)
  HUMIDITY     G/KG    10.9       CATALYST AVG. TEMP. DEG C      401    HYDROCARBONS (THC)   G/KM       1.59    (  1.53)
  TEMPERATURE  DEG C   24.4       CATALYST MAX. TEMP. DEG C      466    CARBON MONOXIDE      G/KM      38.84    ( 35.73)
                                                                        OXIDES OF NITROGEN   G/KM        .46    (   .45)
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TABLE E-16. TEST NO. 513-22 EMISSIONS RESULTS

PVM - 513 SBT VEHICLE EMISSIONS RESULTS - DISABLED EGR AND AIR
PROJECT 11-5402-001

VEHICLE MODEL 79 MERCURY MARQUIS
ENGINE 5.7 L(351 CID) V-8

VEHICLE NO. 51
TRANSMISSION A3
GVW 2434 KG(5365 LBS)

TEST WEIGHT 2041 KG(4500 LBS)
ACTUAL ROAD LOAD 8.9 KW(12.0 HP)
GASOLINE EM-344

TEST NUMBER		513-22	513-23	
TEST CYCLE		SET	HFET	
RUN NUMBER		1	1	
DATE		5/31/79	5/31/79	/ /
ODOMETER		8903KM(5532MILES)	8938KM(5554MILES)	
CVS - BAG CART - DYNAMOMETER		2 - 1 - 3	2 - 1 - 3	
TEMPERATURE DEG. C (DEG. F)		24.4 / 76.0	24.4 / 76.0	
RELATIVE HUMIDITY, PCT		45.1	41.7	
BAROMETER, MM HG(IN HG)		739.9 (29.13)	739.9 (29.13)	
RUN TIME, SECONDS		1397	765	
BLOWER DIF P MM. H2O(IN. H2O)		812.8 (32.0)	812.8 (32.0)	
BLOWER INLET P MM. H2O(IN. H2O)		787.4 (31.0)	800.1 (31.5)	
BLOWER INLET TEMP. DEG. C(DEG. F)		42.8 (109.0)	43.3 (110.0)	
BLOWER REVOLUTIONS		111930	61798	
CVS FLOW STD. CU. METRES(SCF)		208.5 (7364.5)	114.9 (4057.8)	
HC SAMPLE METER/RANGE/PPM		15.5/ 3/ 155	40.6/ 2/ 41	
HC BCKGRD METER/RANGE/PPM		1.4/ 3/ 14	19.9/ 2/ 20	
CO SAMPLE METER/RANGE/PPM		73.8/ 3/ 1947	68.2/12/ 154	
CO BCKGRD METER/RANGE/PPM		.7/ 3/ 16	7.3/12/ 13	
CO2 SAMPLE METER/RANGE/PCT		82.0/ 3/ 1.51	47.8/ 2/ 2.16	
CO2 BCKGRD METER/RANGE/PCT		4.4/ 3/ .07	2.5/ 2/ .09	
NOX SAMPLE METER/RANGE/PPM		18.5/ 2/ 18	62.5/ 2/ 63	
NOX BCKGRD METER/RANGE/PPM		1.2/ 2/ 1	2.6/ 2/ 3	
HC CONCENTRATION PPM		143	24	
CO CONCENTRATION PPM		1848	134	
CO2 CONCENTRATION PCT		1.45	2.08	
NOX CONCENTRATION PPM		17.5	60.3	
HC MASS GRAMS		17.17	1.59	
CO MASS GRAMS		448.77	17.98	
CO2 MASS GRAMS		5545.3	4382.3	
NOX MASS GRAMS		6.55	12.23	
DFC, WET (DRY)		.872 (.865)	.838 (.832)	
SCF, WET (DRY)		1.000 (.978)	1.000 (.973)	
VOL (SCM)		208.5	114.9	
KM (MEASURED)		21.53	16.36	
TEST NUMBER,	PVM-ST	513-22	513-23	
BAROMETER,	MM HG	739.9	739.9	
HUMIDITY,	G/KG	8.8	8.2	
TEMPERATURE,	DEG C	24.4	24.4	
TOTAL FUEL SULFUR,	MG/KM	26.78	24.68	
AVG. EXH. OXYGEN,	PCT	.21	.20	
CATALYST AVG. TEMP.,	DEG C	492	642	
CATALYST MAX. TEMP.,	DEG C	542	652	
CARBON DIOXIDE,	G/KM	257.5	267.8	
FUEL CONSUMPTION,	L/100KM	12.50	11.52	
HYDROCARBONS,	G/KM	.80	.10	
CARBON MONOXIDE,	G/KM	20.84	1.10	
OXIDES OF NITROGEN,	G/KM	.30	.75	

TABLE E-17. TEST NO. 513-31 EMISSIONS RESULTS

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                            PVM - 513   FTP  VEHICLE EMISSIONS RESULTS - DISABLED EGR AND AIR
                                                  PROJECT 11-5402-001

TEST NO.    513-31    RUN   1               VEHICLE NO.   51               TEST WEIGHT    2041 KG(  4500 LBS)
VEHICLE MODEL    79 MERCURY MARQUIS         DATE     6/ 1/79               ACTUAL ROAD LOAD    8.9 KW( 12.0 HP)
ENGINE 5.7 L(351 CID) V-8                   BAG CART NO.  1                GASOLINE   EM-344
TRANSMISSION A3                             DYNO NO.      3                ODOMETER    9043 KM(  5619 MILES)
GVW  2434 KG(  5365 LBS)                    CVS NO.       2

BAROMETER 742.19 MM HG(29.22 IN HG)         DRY BULB TEMP. 24.4 DEG C(76.0 DEG F)
RELATIVE HUMIDITY 59 PCT                    ABS. HUMIDITY 11.6 GM/KG           NOX HUMIDITY CORRECTION FACTOR  1.03
BAG RESULTS
  BAG NUMBER                                      1                 2                 3                 4
  DESCRIPTION                               COLD TRANSIENT      STABILIZED      HOT TRANSIENT       STABILIZED

  BLOWER DIF P MM. H2O(IN. H2O)             812.8 (32.0)      812.8 (32.0)      812.8 (32.0)      812.8 (32.0)
  BLOWER INLET P MM. H2O(IN. H2O)           787.4 (31.0)      787.4 (31.0)      787.4 (31.0)      787.4 (31.0)
  BLOWER INLET TEMP. DEG. C(DEG. F)          42.8 (109.0)      42.8 (109.0)      43.3 (110.0)      43.3 (110.0)
  BLOWER REVOLUTIONS                           40494             69562             40503             69583
  CVS FLOW STD. CU. METRES(SCF)              75.7 (2673.6)    130.0 (4592.6)     75.6 (2671.6)    129.9 (4589.4)
  HC  SAMPLE METER/RANGE/PPM                20.9/ 3/  209     14.6/ 3/  146     11.3/ 3/  113     20.6/ 2/   21
  HC  BCKGRD METER/RANGE/PPM                 1.4/ 3/   14      1.3/ 3/   13      1.1/ 3/   11     10.4/ 2/   10
  CO  SAMPLE METER/RANGE/PPM                91.0/ 3/ 2571     61.1/ 3/ 1544     53.8/ 3/ 1330     95.1/12/  235
  CO  BCKGRD METER/RANGE/PPM                  .1/ 3/    2       .3/ 3/    7       .5/ 3/   11      4.0/12/    7
  CO2 SAMPLE METER/RANGE/PCT                82.5/ 3/ 1.52     54.9/ 3/  .96     74.6/ 3/ 1.36     56.9/ 3/ 1.00
  CO2 BCKGRD METER/RANGE/PCT                 4.1/ 3/  .06      4.0/ 3/  .06      4.1/ 3/  .06      4.0/ 3/  .06
  NOX SAMPLE METER/RANGE/PPM                39.7/ 2/   40      9.1/ 2/    9     39.2/ 2/   39     53.9/ 2/   54
  NOX BCKGRD METER/RANGE/PPM                 2.2/ 2/    2      1.6/ 2/    2      1.3/ 2/    1      1.8/ 2/    2
  DILUTION FACTOR                               7.50              11.91              8.95             13.06

  HC  CONCENTRATION PPM                         197                134               103                11
  CO  CONCENTRATION PPM                        2445               1480              1260               219
  CO2 CONCENTRATION PCT                        1.47                .91              1.30               .94
  NOX CONCENTRATION PPM                        37.8                7.6              38.0              52.2
  HC  MASS GRAMS                               8.60              10.06              4.50               .82
  CO  MASS GRAMS                             215.51             224.04            110.98             33.19
  CO2 MASS GRAMS                             2033.7             2157.7            1804.1            2248.6
  NOX MASS GRAMS                               5.64               1.96              5.67             13.37

  HC  GRAMS/KM                                 1.49               1.65               .78               .13
  CO  GRAMS/KM                                37.30              36.83             19.26              5.40
  CO2 GRAMS/KM                                352.0              354.7             313.0             365.9
  NOX GRAMS/KM                                  .98                .32               .98              2.18
  FUEL CONSUMPTION BY CB L/100KM              17.73              17.83             14.76             16.00

  RUN TIME              SECONDS                505                867               504               868
  AVG. EXH. OXYGEN      PERCENT                 .47                .74               .78               .79
  CATALYST AVG. TEMP.   DEG. C                  322                421               391               448
  CATALYST MAX. TEMP.   DEG. C                  440                436               466               457
  MEASURED DISTANCE     KM                     5.78               6.08              5.76              6.14
      DFC, WET (DRY)                                  .898 ( .886)                        .911 ( .899)
      SCF, WET (DRY)                                 1.000 ( .977)                       1.000 ( .977)
      VOL (SCM)                                             205.7                               205.6
      KM  (MEASURED)                                        11.86                               11.91

COMPOSITE RESULTS                                                                                       3-BAG       (4-BAG)
  TEST NUMBER           513-31     TOTAL FUEL SULFUR    MG/KM   36.34      CARBON DIOXIDE        G/KM      342.6      ( 345.9)
  BAROMETER     MM HG    742.2     AVG. EXH. OXYGEN     PCT       .71      FUEL CONSUMPTION      L/100KM    16.96      ( 16.92)
  HUMIDITY      G/KG      11.6     CATALYST AVG. TEMP.  DEG C     399      HYDROCARBONS (THC)    G/KM        1.38      (   .93)
  TEMPERATURE   DEG C     24.4     CATALYST MAX. TEMP.  DEG C     466      CARBON MONOXIDE       G/KM       32.05      ( 22.84)
                                                                           OXIDES OF NITROGEN    G/KM         .64      (  1.19)
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TABLE E-18. TEST NO. 513-32 EMISSIONS RESULTS

PVM - 513
VEHICLE EMISSIONS RESULTS - DISABLED EGR AND AIR
PROJECT 11-5402-001

VEHICLE MODEL 79 MERCURY MARQUIS
ENGINE 5.7 L(351 CID) V-8

VEHICLE NO. 51
TRANSMISSION A3
GVW 2434 KG(5365 LBS)

TEST WEIGHT 2041 KG(4500 LBS)
ACTUAL ROAD LOAD 8.9 KW(12.0 HP)
GASOLINE EM-344

TEST NUMBER		513-32	513-33	
TEST CYCLE		SET	HFET	
RUN NUMBER		1	1	
DATE		6/ 1/79	6/ 1/79	/ /
ODOMETER		9070KM(5636MILES)	9090KM(5648MILES)	
CVS - BAG CART - DYNAMOMETER		2 - 1 - 3	2 - 1 - 3	
TEMPERATURE DEG. C (DEG. F)		24.4 / 76.0	25.6 / 78.0	
RELATIVE HUMIDITY, PCT		51.9	49.6	
BAROMETER, MM HG(IN HG)		742.9 (29.25)	745.2 (29.34)	
RUN TIME, SECONDS		1397	765	
BLOWER DIF P MM. H2O(IN. H2O)		812.8 (32.0)	850.9 (33.5)	
BLOWER INLET P MM. H2O(IN. H2O)		787.4 (31.0)	825.5 (32.5)	
BLOWER INLET TEMP. DEG. C(DEG. F)		43.3 (110.0)	43.3 (110.0)	
BLOWER REVOLUTIONS		112068	61443	
CVS FLOW STD. CU. METRES(SCF)		209.5 (7400.3)	114.6 (4049.2)	
HC SAMPLE METER/RANGE/PPM		26.6/ 2/ 27	23.5/ 2/ 23	
HC BCKGRD METER/RANGE/PPM		10.4/ 2/ 10	10.9/ 2/ 11	
CO SAMPLE METER/RANGE/PPM		51.1/11/ 194	58.9/13/ 57	
CO BCKGRD METER/RANGE/PPM		1.5/11/ 5	2.8/13/ 3	
CO2 SAMPLE METER/RANGE/PCT		88.4/ 3/ 1.64	46.0/ 2/ 2.06	
CO2 BCKGRD METER/RANGE/PCT		2.9/ 3/ .04	2.0/ 2/ .07	
NOX SAMPLE METER/RANGE/PPM		67.9/ 2/ 68	92.9/ 2/ 93	
NOX BCKGRD METER/RANGE/PPM		3.2/ 2/ 3	4.4/ 2/ 4	
HC CONCENTRATION PPM		17	14	
CO CONCENTRATION PPM		181	51	
CO2 CONCENTRATION PCT		1.61	2.00	
NOX CONCENTRATION PPM		65.1	89.2	
HC MASS GRAMS		2.11	.94	
CO MASS GRAMS		44.14	6.84	
CO2 MASS GRAMS		6161.8	4195.5	
NOX MASS GRAMS		25.61	19.31	
DFC, WET (DRY)		.876 (.867)	.846 (.838)	
SCF, WET (DRY)		1.000 (.974)	1.000 (.971)	
VOL (SCM)		209.5	114.6	
KM (MEASURED)		21.40	16.23	
TEST NUMBER,	PVM-ST	513-32	513-33	
BAROMETER,	MM HG	742.9	745.2	
HUMIDITY,	G/KG	10.1	10.3	
TEMPERATURE,	DEG C	24.4	25.6	
TOTAL FUEL SULFUR,	MG/KM	26.66	23.72	
AVG. EXH. OXYGEN,	PCT	.51	.29	
CATALYST AVG. TEMP.,	DEG C	540	619	
CATALYST MAX. TEMP.,	DEG C	639	636	
CARBON DIOXIDE,	G/KM	287.9	258.5	
FUEL CONSUMPTION,	L/100KM	12.44	11.07	
HYDROCARBONS,	G/KM	.10	.06	
CARBON MONOXIDE,	G/KM	2.06	.42	
OXIDES OF NITROGEN,	G/KM	1.20	1.19	

TABLE E-19. TEST NO. 514-11 EMISSIONS RESULTS

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                    PVM - 514   FTP  VEHICLE EMISSIONS RESULTS - UNMODIFIED
                                     PROJECT 11-5402-001

TEST NO.    514-11    RUN   1               VEHICLE NO.   51                  TEST WEIGHT    2041 KG(  4500 LBS)
VEHICLE MODEL   79 MERCURY MARQUIS          DATE     5/10/79                  ACTUAL ROAD LOAD   8.9 KW( 12.0 HP)
ENGINE 5.7 L(351 CID) V-8                   BAG CART NO.   1                  GASOLINE  EM-344
TRANSMISSION A3                             DYNO NO.       3                  ODOMETER    6051 KM(  3760 MILES)
GVW  2434 KG(  5365 LBS)                    CVS NO.        2

BAROMETER 735.08 MM HG(28.94 IN HG)         DRY BULB TEMP. 24.4 DEG C(76.0 DEG F)
RELATIVE HUMIDITY 59 PCT                    ABS. HUMIDITY 11.7 GM/KG              NOX HUMIDITY CORRECTION FACTOR  1.03
BAG RESULTS
   B:G NUMBER                                      1                  2                  3                  4
   DESCRIPTION                              COLD TRANSIENT       STABILIZED         HOT TRANSIENT       STABILIZED

   BLOWER DIF P MM. H2O(IN. H2O)             800.1 (31.5)       800.1 (31.5)       800.1 (31.5)       800.1 (31.5)
   BLOWER INLET P MM. H2O(IN. H2O)           787.4 (31.0)       787.4 (31.0)       787.4 (31.0)       787.4 (31.0)
   BLOWER INLET TEMP. DEG. C(DEG. F)          43.3 (110.0)       43.3 (110.0)       43.3 (110.0)       43.3 (110.0)
   BLOWER REVOLUTIONS                            40685              69657              40610              69681
   CVS FLOW STD. CU. METRES(SCF)              75.2 (2656.9)     128.8 (4547.9)      75.1 (2651.6)     128.8 (4549.3)
   HC  SAMPLE METER/RANGE/PPM                63.4/ 2/   63      22.8/ 2/   23      29.3/ 2/   29      24.0/ 2/   24
   HC  BCKGRD METER/RANGE/PPM                18.1/ 2/   18      17.9/ 2/   18      19.1/ 2/   19      19.6/ 2/   20
   CO  SAMPLE METER/RANGE/PPM                91.1/11/  455      21.5/13/   20      59.7/13/   57      19.7/13/   19
   CO  BCKGRD METER/RANGE/PPM                 2.3/11/    7       4.8/13/    5       3.2/13/    3       2.4/13/    2
   CO2 SAMPLE METER/RANGE/PCT                87.2/ 3/ 1.62      59.4/ 3/ 1.05      78.2/ 3/ 1.43      58.2/ 3/ 1.03
   CO2 BCKGRD METER/RANGE/PCT                 3.5/ 3/  .05       3.1/ 3/  .05       3.3/ 3/  .05       3.4/ 3/  .05
   NOX SAMPLE METER/RANGE/PPM                49.8/ 2/   50      14.8/ 2/   15      30.4/ 2/   30      15.3/ 2/   15
   NOX BCKGRD METER/RANGE/PPM                 1.7/ 2/    2       1.7/ 2/    2       1.3/ 2/    1       1.2/ 2/    1
   DILUTION FACTOR                               8.03               12.70               9.30              12.99

   HC  CONCENTRATION PPM                          48                  6                 12                  6
   CO  CONCENTRATION PPM                         426                 15                 52                 16
   CO2 CONCENTRATION PCT                        1.57               1.01               1.39                .98
   NOX CONCENTRATION PPM                        48.3               13.2               29.2               14.2
   HC  MASS GRAMS                               2.06                .47                .53                .44
   CO  MASS GRAMS                              37.30               2.31               4.55               2.39
   CO2 MASS GRAMS                             2166.5             2375.4             1907.4             2309.7
   NOX MASS GRAMS                               7.19               3.37               4.34               3.62

   HC  GRAMS/KM                                  .36                .08                .09                .07
   CO  GRAMS/KM                                 6.49                .38                .80                .39
   CO2 GRAMS/KM                                377.3              388.1              335.2              377.6
   NOX GRAMS/KM                                 1.25                .55                .76                .59
   FUEL CONSUMPTION BY CB L/100KM              16.59              16.60              14.37              16.15

   RUN TIME              SECONDS                 505                868                505                869
   AVG. EXH. OXYGEN      PERCENT                3.47               3.76               3.63               3.71
   CATALYST AVG. TEMP.   DEG. C                  434                491                459                496
   CATALYST MAX. TEMP.   DEG. C                  563                542                533                550
   MEASURED DISTANCE     KM                     5.74               6.12               5.69               6.12
        DFC, WET (DRY)                                  .904 ( .893)                           .912 ( .900)
        SCF, WET (DRY)                                 1.000 ( .976)                          1.000 ( .976)
        VOL (SCM)                                              204.0                                  203.9
        KM  (MEASURED)                                         11.86                                  11.81

COMPOSITE RESULTS                                                                                3-BAG        (4-BAG)
   TEST NUMBER            514-11       TOTAL FUEL SULFUR    MG/KM   34.26    CARBON DIOXIDE       G/KM      371.3       ( 368.2)
   BAROMETER      MM HG   735.1        AVG. EXH. OXYGEN     PCT      3.69    FUEL CONSUMPTION     L/100KM   15.99       ( 15.85)
   HUMIDITY       G/KG     11.7        CATALYST AVG. TEMP. DEG C     475     HYDROCARBONS (THC)   G/KM        .14       (   .14)
   TEMPERATURE    DEG C    24.4        CATALYST MAX. TEMP. DEG C     563     CARBON MONOXIDE      G/KM       1.77       (  1.77)
                                                                             OXIDES OF NITROGEN   G/KM        .76       (   .77)
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TABLE E-20. TEST NO. 514-12 EMISSIONS RESULTS

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                          PVM - 514   SAT  VEHICLE EMISSIONS RESULTS - UNMODIFIED
                                        PROJECT 11-5402-001

                                       VEHICLE NO.     51                       TEST WEIGHT    2041 KG(  4500 LBS)
VEHICLE MODEL    79 MERCURY MARQUIS    TRANSMISSION A3                          ACTUAL ROAD LOAD    8.9 KW( 12.0 HP)
ENGINE 5.7 L(351 CID) V-8              GVW  2434 KG(  5365 LBS)                 GASOLINE  EM-344

   TEST NUMBER                               514-12                514-13
   TEST CYCLE                                 SET                   HFET
   RUN NUMBER                                  1                     1
   DATE                                     5/10/79               5/10/79                        / /
   ODOMETER                           6080KM(  3778MILES)   6103KM(  3792MILES)
   CVS - BAG CART - DYNAMOMETER             2 - 1 - 3             2 - 1 - 3

   TEMPERATURE DEG. C (DEG. F)            26.1 / 79.0           26.7 / 80.0
   RELATIVE HUMIDITY, PCT                     50.4                  44.5
   BAROMETER, MM HG(IN HG)               735.1 (28.94)         735.1 (28.94)
   RUN TIME, SECONDS                          1398                   767

   BLOWER DIF P MM. H20(IN. H20)         800.1 (31.5)          800.1 (31.5)
   BLOWER INLET P MM. H20(IN. H20)       787.4 (31.0)          787.4 (31.0)
   BLOWER INLET TEMP. DEG. C(DEG. F)      43.3 (110.0)          43.3 (110.0)
   BLOWER REVOLUTIONS                       112057                 61584
   CVS FLOW STD. CU. METRES(SCF)         205.5 (7257.1)        112.9 (3988.6)
   HC   SAMPLE METER/RANGE/PPM           23.0/ 2/   23         16.3/ 2/   16
   HC   BCKGRD METER/RANGE/PPM           20.4/ 2/   20         16.0/ 2/   16
   CO   SAMPLE METER/RANGE/PPM           29.9/13/   28          3.9/13/    4
   CO   BCKGRD METER/RANGE/PPM             .9/13/    1           .2/13/    0
   CO2 SAMPLE METER/RANGE/PCT            85.9/ 3/ 1.59         43.6/ 2/ 1.93
   CO2 BCKGRD METER/RANGE/PCT             3.8/ 3/  .06          1.8/ 2/  .07
   NOX SAMPLE METER/RANGE/PPM            41.6/ 2/   42         61.8/ 2/   62
   NOX BCKGRD METER/RANGE/PPM             1.8/ 2/    2          1.8/ 2/    2
   HC   CONCENTRATION PPM                       5                     3
   CO   CONCENTRATION PPM                      26                     3
   CO2 CONCENTRATION PCT                     1.54                  1.87
   NOX CONCENTRATION PPM                     40.0                  60.3
   HC   MASS GRAMS                            .60                   .17
   CO   MASS GRAMS                           6.27                   .45
   CO2 MASS GRAMS                          5798.9                3875.3
   NOX MASS GRAMS                           15.88                 12.73
        DFC, WET (DRY)                  .881 ( .872)          .856 ( .849)
        SCF, WET (DRY)                 1.000 ( .975)         1.000 ( .974)
        VOL (SCM)                          205.5                 112.9
        KM  (MEASURED)                     21.85                 16.20

   TEST NUMBER,         PVM-ST             514-12                514-13
   BAROMETER,           MM HG               735.1                 735.1
   HUMIDITY,            G/KG                 11.0                  10.0
   TEMPERATURE,         DEG C                26.1                  26.7
   TOTAL FUEL SULFUR,   MG/KM               24.33                 21.89

   AVG. EXH. OXYGEN,    PCT                  3.69                  2.93
   CATALYST AVG. TEMP., DEG C                 543                   591
   CATALYST MAX. TEMP., DEG C                 606                   627
   CARBON DIOXIDE,      G/KM                265.4                 239.2
   FUEL CONSUMPTION,    L/100KM             11.35                 10.21

   HYDROCARBONS,        G/KM                  .03                   .01
   CARBON MONOXIDE,     G/KM                  .29                   .03
   OXIDES OF NITROGEN,  G/KM                  .73                   .79
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TABLE E-21. TEST NO. 514-21 EMISSIONS RESULTS

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                         PVM - 514   FTP  VEHICLE EMISSIONS RESULTS - DISCONNECTED CTS
                                             PROJECT 11-5402-001

TEST NO.   514-21    RUN   1                          VEHICLE NO.   51                TEST WEIGHT   2041 KG(  4500 LBS)
VEHICLE MODEL   79 MERCURY MARQUIS                    DATE    5/15/79                 ACTUAL ROAD LOAD   8.9 KW( 12.0 HP)
ENGINE 5.7 L(351 CID) V-8                             BAG CART NO.  1                 GASOLINE   EM-344
TRANSMISSION A3                                       DYNO NO.      3                 ODOMETER    6444 KM(  4004 MILES)
GVW  2434 KG(  5365 LBS)                              CVS NO.       2

BAROMETER 746.25 MM HG(29.38 IN HG)                   DRY BULB TEMP. 21.1 DEG C(70.0 DEG F)
RELATIVE HUMIDITY 56 PCT                              ABS. HUMIDITY  8.8 GM/KG        NOX HUMIDITY CORRECTION FACTOR    .94
BAG RESULTS
   BAG NUMBER                                              1                  2                  3                   4
   DESCRIPTION                                      COLD TRANSIENT       STABILIZED        HOT TRANSIENT        STABILIZED

   BLOWER DIF P MM. H2O(IN. H2O)                    812.8 (32.0)        812.8 (32.0)       812.8 (32.0)        812.8 (32.0)
   BLOWER INLET P MM. H2O(IN. H2O)                  787.4 (31.0)        787.4 (31.0)       787.4 (31.0)        787.4 (31.0)
   BLOWER INLET TEMP. DEG. C(DEG. F)                 43.3 (110.0)        43.3 (110.0)       43.3 (110.0)        43.3 (110.0)
   BLOWER REVOLUTIONS                                  40600               70450              40460               69652
   CVS FLOW STD. CU. METRES(SCF)                    76.3 (2694.5)      132.4 (4677.3)      76.0 (2684.7)      130.9 (4622.0)
   HC   SAMPLE METER/RANGE/PPM                      25.2/ 3/  252       17.9/ 3/  179      21.0/ 3/  210       18.0/ 3/  180
   HC   BCKGRD METER/RANGE/PPM                       1.3/ 3/   13        1.7/ 3/   17       1.6/ 3/   16        1.6/ 3/   16
   CO   SAMPLE METER/RANGE/PPM                      62.8/ 2/ 3247       53.6/ 2/ 2621      61.4/ 2/ 3148       57.4/ 2/ 2872
   CO   BCKGRD METER/RANGE/PPM                        .7/ 2/   27         .6/ 2/   23        .7/ 2/   27         .8/ 2/   30
   CO2  SAMPLE METER/RANGE/PCT                      79.1/ 3/ 1.45       55.2/ 3/  .97      74.5/ 3/ 1.36       54.8/ 3/  .96
   CO2  BCKGRD METER/RANGE/PCT                       3.9/ 3/  .06        4.0/ 3/  .06       4.2/ 3/  .06        4.1/ 3/  .06
   NOX  SAMPLE METER/RANGE/PPM                      27.8/ 2/   28        6.2/ 2/    6      16.3/ 2/   16        6.1/ 2/    6
   NOX  BCKGRD METER/RANGE/PPM                       1.3/ 2/    1         .8/ 2/    1       1.0/ 2/    1        1.0/ 2/    1
   DILUTION FACTOR                                      7.50               10.82               7.99               10.68

   HC   CONCENTRATION PPM                               241                 164                196                 165
   CO   CONCENTRATION PPM                              3076                2505               2986                2740
   CO2  CONCENTRATION PCT                              1.40                 .91               1.30                 .90
   NOX  CONCENTRATION PPM                              26.7                 5.5               15.4                 5.2
   HC   MASS GRAMS                                    10.59               12.49               8.59               12.49
   CO   MASS GRAMS                                   273.23              386.27             264.31              417.50
   CO2  MASS GRAMS                                   1954.8              2213.0             1809.3              2164.8
   NOX  MASS GRAMS                                     3.67                1.31               2.11                1.22

   HC   GRAMS/KM                                       1.84                2.01               1.50                2.01
   CO   GRAMS/KM                                      47.42               62.13              46.00               67.16
   CO2  GRAMS/KM                                      339.3               356.0              314.9               348.2
   NOX  GRAMS/KM                                        .64                 .21                .37                 .20
   FUEL CONSUMPTION BY CB L/100KM                     17.91               19.63              16.73               19.64

   RUN TIME               SECONDS                       505                 869                505                 868
   AVG. EXH. OXYGEN       PERCENT                       .60                 .42                .36                 .37
   CATALYST AVG. TEMP.    DEG. C                        348                 460                428                 457
   CATALYST MAX. TEMP.    DEG. C                        504                 482                529                 469
   MEASURED DISTANCE      KM                           5.76                6.22               5.75                6.22
        DFC, WET (DRY)                                       .893 ( .882)                           .895 ( .884)
        SCF, WET (DRY)                                      1.000 ( .978)                          1.000 ( .978)
        VOL (SCM)                                                  208.7                                  206.9
        KM  (MEASURED)                                             11.98                                  11.96

COMPOSITE RESULTS                                                                                        3-BAG        (4-BAG)
   TEST NUMBER             514-21      TOTAL FUEL SULFUR   MG/KM   39.61      CARBON DIOXIDE        G/KM       341.3       ( 339.0)
   BAROMETER      MM HG    746.3       AVG. EXH. OXYGEN    PCT       .43      FUEL CONSUMPTION      L/100KM     18.48       ( 18.48)
   HUMIDITY       G/KG       8.8       CATALYST AVG. TEMP. DEG C     436      HYDROCARBONS (THC)    G/KM         1.83       (  1.83)
   TEMPERATURE    DEG C     21.1       CATALYST MAX. TEMP. DEG C     529      CARBON MONOXIDE       G/KM        54.67       ( 56.16)
                                                                              OXIDES OF NITROGEN    G/KM          .34       (   .34)
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TABLE E-22. TEST NO. 514-22 EMISSIONS RESULTS

PVM - 514   SBT   VEHICLE EMISSIONS RESULTS - DISCONNECTED CTS
PROJECT 11-5402-001

VEHICLE MODEL   79 MERCURY MARQUIS
ENGINE 5.7 L(351 CID) V-8

VEHICLE NO.   51
TRANSMISSION A3
GVW 2434 KG(5365 LBS)

TEST WEIGHT   2041 KG(4500 LBS)
ACTUAL ROAD LOAD   8.9 KW(12.0 HP)
GASOLINE EM-344

TEST NUMBER	514-22	514-23	
TEST CYCLE	SET	HFET	
RUN NUMBER	1	1	
DATE	5/15/79	5/15/79	/ /
ODOMETER	6473KM(4022MILES)	6508KM(4044MILES)	
CVS - BAG CART - DYNAMOMETER	2 - 1 - 3	2 - 1 - 3	
TEMPERATURE DEG. C (DEG. F)	22.8 / 73.0	23.3 / 74.0	
RELATIVE HUMIDITY, PCT	46.3	40.1	
BAROMETER, MM HG(IN HG)	746.3 (29.38)	746.3 (29.38)	
RUN TIME, SECONDS	1397	766	
BLOWER DIF P MM. H2O(IN. H2O)	812.8 (32.0)	812.8 (32.0)	
BLOWER INLET P MM. H2O(IN. H2O)	787.4 (31.0)	787.4 (31.0)	
BLOWER INLET TEMP. DEG. C(DEG. F)	43.3 (110.0)	43.3 (110.0)	
BLOWER REVOLUTIONS	111854	61477	
CVS FLOW STD. CU. METRES(SCF)	210.1 (7421.9)	115.5 (4079.6)	
HC SAMPLE METER/RANGE/PPM	19.7/ 3/ 197	22.4/ 3/ 224	
HC BCKGRD METER/RANGE/PPM	1.4/ 3/ 14	1.6/ 3/ 16	
CO SAMPLE METER/RANGE/PPM	64.8/ 2/ 3393	75.6/ 2/ 4239	
CO BCKGRD METER/RANGE/PPM	1.1/ 2/ 42	1.7/ 2/ 65	
CO2 SAMPLE METER/RANGE/PCT	77.5/ 3/ 1.42	96.3/ 3/ 1.81	
CO2 BCKGRD METER/RANGE/PCT	4.2/ 3/ .06	4.7/ 3/ .07	
NOX SAMPLE METER/RANGE/PPM	15.8/ 2/ 16	18.2/ 2/ 18	
NOX BCKGRD METER/RANGE/PPM	.6/ 2/ 1	.7/ 2/ 1	
HC CONCENTRATION PPM	185	211	
CO CONCENTRATION PPM	3214	3984	
CO2 CONCENTRATION PCT	1.36	1.75	
NOX CONCENTRATION PPM	15.3	17.6	
HC MASS GRAMS	22.40	14.03	
CO MASS GRAMS	786.39	535.81	
CO2 MASS GRAMS	5241.2	3702.5	
NOX MASS GRAMS	5.66	3.50	
DFC, WET (DRY)	.868 (.861)	.833 (.828)	
SCF, WET (DRY)	1.000 (.978)	1.000 (.977)	
VOL (SCM)	210.1	115.5	
KM (MEASURED)	21.47	16.37	

TEST NUMBER,	PVM-ST	514-22	514-23
BAROMETER,	MM HG	746.3	746.3
HUMIDITY,	G/KG	8.1	7.3
TEMPERATURE,	DEG C	22.8	23.3
TOTAL FUEL SULFUR,	MG/KM	27.89	25.64
AVG. EXH. OXYGEN,	PCT	.25	.08
CATALYST AVG. TEMP.,	DEG C	519	573
CATALYST MAX. TEMP.,	DEG C	597	614
CARBON DIOXIDE,	G/KM	244.1	226.1
FUEL CONSUMPTION,	L/100KM	13.01	11.96
HYDROCARBONS,	G/KM	1.04	.86
CARBON MONOXIDE,	G/KM	36.62	32.73
OXIDES OF NITROGEN,	G/KM	.26	.21

TABLE E-23. TEST NO. 514-31 EMISSIONS RESULTS

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                              PVM - 514   FTP  VEHICLE EMISSIONS RESULTS - DISCONNECTED CTS
                                                  PROJECT 11-5402-001

TEST NO.   514-31   RUN   1                     VEHICLE NO.   51                     TEST WEIGHT   2041 KG(  4500 LBS)
VEHICLE MODEL   79 MERCURY MARQUIS              DATE     5/16/79                     ACTUAL ROAD LOAD   8.9 KW( 12.0 HP)
ENGINE 5.7 L(351 CID) V-8                       BAG CART NO.  1                      GASOLINE  EM-344
TRANSMISSION A3                                 DYNO NO.      3                      ODOMETER   6544 KM(  4066 MILES)
GVW  2434 KG(  5365 LBS)                        CVS NO.       2

BAROMETER 744.98 MM HG(29.33 IN HG)             DRY BULB TEMP. 24.4 DEG C(76.0 DEG F)
RELATIVE HUMIDITY 52 PCT                        ABS. HUMIDITY 10.1 GM/KG             NOX HUMIDITY CORRECTION FACTOR   .98
BAG RESULTS
   BAG NUMBER                                        1                  2                  3                  4
   DESCRIPTION                                 COLD TRANSIENT       STABILIZED        HOT TRANSIENT       STABILIZED

   BLOWER DIF P MM. H2O(IN. H2O)               812.8 (32.0)       812.8 (32.0)       812.8 (32.0)       812.8 (32.0)
   BLOWER INLET P MM. H2O(IN. H2O)             787.4 (31.0)       787.4 (31.0)       787.4 (31.0)       787.4 (31.0)
   BLOWER INLET TEMP. DEG. C(DEG. F)            43.3 (110.0)       43.3 (110.0)       43.3 (110.0)       43.3 (110.0)
   BLOWER REVOLUTIONS                              40616              70379              40613              70563
   CVS FLOW STD. CU. METRES(SCF)               76.2 (2690.7)     132.0 (4663.6)      76.2 (2690.4)     132.4 (4676.5)
   HC  SAMPLE METER/RANGE/PPM                 27.0/ 3/  270      17.2/ 3/  172      20.1/ 3/  201      16.7/ 3/  167
   HC  BCKGRD METER/RANGE/PPM                  2.0/ 3/   20       2.2/ 3/   22       1.7/ 3/   17       1.8/ 3/   18
   CO  SAMPLE METER/RANGE/PPM                 62.2/ 2/ 3204      50.1/ 2/ 2400      56.4/ 2/ 2805      49.9/ 2/ 2388
   CO  BCKGRD METER/RANGE/PPM                  1.1/ 2/   42       1.2/ 2/   46        .7/ 2/   27        .7/ 2/   27
   CO2 SAMPLE METER/RANGE/PCT                 77.9/ 3/ 1.43      56.9/ 3/ 1.00      75.7/ 3/ 1.38      56.5/ 3/  .99
   CO2 BCKGRD METER/RANGE/PCT                  3.8/ 3/  .06       4.0/ 3/  .06       4.0/ 3/  .06       4.3/ 3/  .07
   NOX SAMPLE METER/RANGE/PPM                 33.6/ 2/   34       7.7/ 2/    8      17.7/ 2/   18       6.8/ 2/    7
   NOX BCKGRD METER/RANGE/PPM                  2.4/ 2/    2       2.2/ 2/    2       1.7/ 2/    2       1.6/ 2/    2
   DILUTION FACTOR                                 7.62              10.72               8.03              10.80

   HC  CONCENTRATION PPM                           253                152                186                151
   CO  CONCENTRATION PPM                          3027               2273               2660               2278
   CO2 CONCENTRATION PCT                          1.38                .95               1.33                .93
   NOX CONCENTRATION PPM                          31.5                5.7               16.2                5.3
   HC  MASS GRAMS                                11.10              11.58               8.18              11.51
   CO  MASS GRAMS                               268.54             349.49             235.97             351.29
   CO2 MASS GRAMS                               1919.1             2287.4             1851.3             2264.2
   NOX MASS GRAMS                                 4.50               1.41               2.32               1.33

   HC  GRAMS/KM                                   1.93               1.87               1.42               1.86
   CO  GRAMS/KM                                  46.67              56.42              40.93              56.71
   CO2 GRAMS/KM                                  333.5              369.2              321.1              365.5
   NOX GRAMS/KM                                    .78                .23                .40                .21
   FUEL CONSUMPTION BY CB L/100KM                17.63              19.80              16.64              19.65

   RUN TIME                SECONDS                 504                869                504                868
   AVG. EXH. OXYGEN        PERCENT                 .32               0.00                .32                .28
   CATALYST AVG. TEMP.     DEG. C                  343                 -                 421                460
   CATALYST MAX. TEMP.     DEG. C                  499                478                525                495
   MEASURED DISTANCE       KM                     5.75               6.19               5.76               6.19
        DFC, WET (DRY)                                    .893 ( .884)                         .896 ( .887)
        SCF, WET (DRY)                                   1.000 ( .979)                        1.000 ( .979)
        VOL (SCM)                                                208.2                                208.6
        KM  (MEASURED)                                           11.95                                11.96

COMPOSITE RESULTS                                                                                         3-BAG       (4-BAG)
   TEST NUMBER          514-31      TOTAL FUEL SULFUR    MG/KM   39.61     CARBON DIOXIDE        G/KM      348.6      ( 347.5)
   BAROMETER    MM HG   745.0       AVG. EXH. OXYGEN     PCT       .12     FUEL CONSUMPTION      L/100KM   18.48      ( 18.44)
   HUMIDITY     G/KG     10.1       CATALYST AVG. TEMP. DEG C       -      HYDROCARBONS (THC)    G/KM       1.76      (  1.75)
   TEMPERATURE  DEG C    24.4       CATALYST MAX. TEMP. DEG C     525      CARBON MONOXIDE       G/KM      50.14      ( 50.23)
                                                                           OXIDES OF NITROGEN    G/KM        .39      (   .39)
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TABLE E-24. TEST NO. 514-32 EMISSIONS RESULTS

PVM - 514 SBT VEHICLE EMISSIONS RESULTS - DISCONNECTED CTS
PROJECT 11-5402-001

VEHICLE MODEL 79 MERCURY MARQUIS
ENGINE 5.7 L(351 CID) V-8

VEHICLE NO. 51
TRANSMISSION A3
GVW 2434 KG(5365 LBS)

TEST WEIGHT 2041 KG(4500 LBS)
ACTUAL ROAD LOAD 8.9 KW(12.0 HP)
GASOLINE EM-344

TEST NUMBER		514-32	514-33	
TEST CYCLE		SET	HFET	
RUN NUMBER		1	1	
DATE		5/16/79	5/16/79	/ /
ODOMETER		6573KM(4084MILES)	6592KM(4096MILES)	
CVS - BAG CART - DYNAMOMETER		2 - 1 - 3	2 - 1 - 3	
TEMPERATURE DEG. C (DEG. F)		23.9 / 75.0	24.4 / 76.0	
RELATIVE HUMIDITY, PCT		40.8	44.9	
BAROMETER, MM HG(IN HG)		746.3 (29.38)	746.3 (29.38)	
RUN TIME, SECONDS		1397	765	
BLOWER DIF P MM. H2O(IN. H2O)		812.8 (32.0)	812.8 (32.0)	
BLOWER INLET P MM. H2O(IN. H2O)		787.4 (31.0)	787.4 (31.0)	
BLOWER INLET TEMP. DEG. C(DEG. F)		43.3 (110.0)	43.3 (110.0)	
BLOWER REVOLUTIONS		112650	61886	
CVS FLOW STD. CU. METRES(SCF)		211.7 (7477.1)	116.3 (4108.2)	
HC SAMPLE METER/RANGE/PPM		20.0/ 3/ 200	22.3/ 3/ 223	
HC BCKGRD METER/RANGE/PPM		1.3/ 3/ 13	2.0/ 3/ 20	
CO SAMPLE METER/RANGE/PPM		63.6/ 2/ 3305	74.3/ 2/ 4132	
CO BCKGRD METER/RANGE/PPM		.8/ 2/ 30	1.3/ 2/ 49	
CO2 SAMPLE METER/RANGE/PCT		78.2/ 3/ 1.43	96.1/ 3/ 1.81	
CO2 BCKGRD METER/RANGE/PCT		3.8/ 3/ .06	4.2/ 3/ .06	
NOX SAMPLE METER/RANGE/PPM		16.0/ 2/ 16	16.9/ 2/ 17	
NOX BCKGRD METER/RANGE/PPM		.6/ 2/ 1	.3/ 2/ 0	
HC CONCENTRATION PPM		189	206	
CO CONCENTRATION PPM		3144	3888	
CO2 CONCENTRATION PCT		1.38	1.75	
NOX CONCENTRATION PPM		15.5	16.6	
HC MASS GRAMS		23.04	13.84	
CO MASS GRAMS		775.16	526.57	
CO2 MASS GRAMS		5357.2	3733.1	
NOX MASS GRAMS		5.70	3.48	
DFC, WET (DRY)		.868 (.862)	.834 (.828)	
SCF, WET (DRY)		1.000 (.980)	1.000 (.975)	
VOL (SCM)		211.7	116.3	
KM (MEASURED)		21.84	16.42	
TEST NUMBER,	PVM-ST	514-32	514-33	
BAROMETER,	MM HG	746.3	746.3	
HUMIDITY,	G/KG	7.7	8.7	
TEMPERATURE,	DEG C	23.9	24.4	
TOTAL FUEL SULFUR,	MG/KM	27.84	25.66	
AVG. EXH. OXYGEN,	PCT	.19	.08	
CATALYST AVG. TEMP.,	DEG C	522	583	
CATALYST MAX. TEMP.,	DEG C	601	618	
CARBON DIOXIDE,	G/KM	245.3	227.4	
FUEL CONSUMPTION,	L/100KM	12.99	11.97	
HYDROCARBONS,	G/KM	1.06	.84	
CARBON MONOXIDE,	G/KM	35.49	32.08	
OXIDES OF NITROGEN,	G/KM	.26	.21	

APPENDIX F

SHORT-TEST PROCEDURE RESULTS

TABLE F-1. CAR 51 - SHORT TEST PROCEDURES RESULTS

		Transient Cycle Tests				Steady State Raw Emissions Tests				
						TSIT		FTM		
UNMODIFIED		FTP	NYCC	FSC		2500	IDLE	52 MPH	25 MPH	IDLE
Barometer,	mm Hg	740.2	739.9	739.9						
Humidity,	g/kg	11.1	9.9	8.8						
Temperature,	°C	25.6	26.7	27.8						
Carbon Dioxide,	g/km	358.5	741.2	311.0						
Fuel Cons.,	ℓ/100km	15.41	31.76	13.35						
Hydrocarbons,	g/km	0.12	0.15	0.05	ppmH*	58	59	67	67	67
Carbon Monoxide,	g/km	1.35	1.55	1.02	%	0	0	0	0	0
Oxides of Nitrogen,	g/km	0.85	1.00	0.48	ppmNO	240	35	925	263	35
511-2 Disabled O_2 Sensor		FTP	NYCC	FSC		2500	IDLE	52 MPH	25 MPH	IDLE
Barometer,	mm Hg	737.6	738.9	738.9						
Humidity,	g/kg	10.2	9.0	8.6						
Temperature,	°C	24.4	27.2	26.7						
Carbon Dioxide,	g/km	354.7	647.4	278.1						
Fuel Cons.,	ℓ/100km	15.21	27.65	11.88						
Hydrocarbons,	g/km	0.09	0.07	0.03	ppmH*	67	261	71	49	261
Carbon Monoxide,	g/km	0.82	0.13	0.04	%	0	0.3	<0.01	0	0.3
Oxides of Nitrogen,	g/km	2.42	1.79	2.51	ppmNO	388	12	2288	830	17
514-2 Disconnected CTS		FTP	NYCC	FSC		2500	IDLE	52 MPH	25 MPH	IDLE
Barometer,	mm Hg	746.3	746.3	746.3						
Humidity,	g/kg	8.8	7.7	10.6						
Temperature,	°C	21.1	23.9	23.3						
Carbon Dioxide,	g/km	341.3	707.1	289.9						
Fuel Cons.,	ℓ/100km	18.48	39.06	15.55						
Hydrocarbons,	g/km	1.83	4.14	1.55	ppmH*	162	241	130	183	256
Carbon Monoxide,	g/km	54.67	124.11	44.27	%	2.7	2.9	1.9	4.0	3.2
Oxides of Nitrogen,	g/km	0.34	0.43	0.27	ppmNO	52	3	250	22	3

TABLE F-1 (Cont'd). CAR 51 - SHORT TEST PROCEDURES RESULTS

		Transient Cycle Tests				Steady State Emissions Tests				
						TSIT		FTM		
513-2 Disabled EGR & Air		FTP	NYCC	FSC		2500	IDLE	52 MPH	25 MPH	IDLE
Barometer,	mm Hg	739.9	739.9	739.9						
Humidity,	g/kg	10.9	7.9	8.3						
Temperature,	°C	24.4	25.0	25.6						
Carbon Dioxide,	g/km	338.6	725.6	300.9						
Fuel Cons.,	ℓ/100km	17.27	31.60	12.98						
Hydrocarbons,	g/km	1.59	0.40	0.12	ppmH*	178	406	157	237	429
Carbon Monoxide,	g/km	38.84	8.62	1.90	%	2.5	3.9	1.9	3.6	4.3
Oxides of Nitrogen,	g/km	0.46	1.66	1.92	ppm	120	7	470	86	6
512-2 12 Pct. Misfire		FTP	NYCC	FSC		2500	IDLE	52 MPH	25 MPH	IDLE
Barometer,	mm Hg	744.2	744.2	744.2						
Humidity,	g/kg	11.8	11.8	12.3						
Temperature,	°C	23.9	23.9	21.1						
Carbon Dioxide,	g/km	368.9	723.9	306.2						
Fuel Cons.,	ℓ/100km	16.58	31.32	13.08						
Hydrocarbons,	g/km	1.82	0.55	0.04	ppmH*	69	115	81	75	74
Carbon Monoxide,	g/km	8.86	5.16	0.15	%	<0.01	0.09	<0.01	<0.01	0.03
Oxides of Nitrogen,	g/km	0.61	1.98	1.18	ppm	150	1	850	100	2

*ppmH - Hydrocarbons as ppm Hexane measured using an Infrared Emission Analyzer

FTP - Light Duty Federal Test Procedure
NYCC - New York City Cycle
FSC - Federal Short Cycle
TSIT - Two Speed Idle Test
FTM - Federal Three Mode

TABLE F-2. CAR 51 - SHORT TEST REPEATS

	Steady-State Raw Emissions Tests				
	TSIT		FTM		
	2500	IDLE	52 MPH	25 MPH	IDLE
Unmodified					
Hydrocarbons, ppmH*	61	63	63	61	64
Carbon Monoxide, %	0.01	0.01	<0.01	<0.01	<0.01
Oxides of Nitrogen, ppm	215	27	700	185	40
511-2 Disabled O_2 Sensor					
Hydrocarbons, ppmH*	73	363	80	75	382
Carbon Monoxide, %	0.01	3.9	0.01	0.01	4.1
Oxides of Nitrogen, ppm	293	5	1788	425	5
512-2 12 Pct. Misfire					
Hydrocarbons, ppmH*	64	175	74	66	88
Carbon Monoxide, %	0.01	0.13	<0.01	<0.01	0.05
Oxides of Nitrogen, ppm	200	1	400	32	2
513-2 Disabled EGR and Air					
Hydrocarbons, ppmH*	183	355	159	241	382
Carbon Monixide, %	1.9	3.4	1.5	2.9	3.6
Oxides of Nitrogen, ppm	70	5	340	100	3
514-2 Disconnected CTS					
Hydrocarbons, ppmH*	220	310	187	256	305
Carbon Monoxide, %	3.2	3.9	2.5	4.8	3.7
Oxides of Nitrogen, ppm	120	12	485	37	12

* ppmH - Hydrocarbons as ppm Hexane measured using an Infrared Emission Analyzer

APPENDIX G

AVERAGE VALUES FOR UNMODIFIED CONFIGURATION

TABLE G-1. AVERAGE, MINIMUM AND MAXIMUM VALUES FOR THE UNMODIFIED CONFIGURATION
1979 Mercury Marquis with Three-Way Catalyst

	EMISSION RATE, MG/KM (Except as Noted)								
	FTP			SET			HFET		
	AVG	MIN	MAX	AVG	MIN	MAX	AVG	MIN	MAX
Test Number, PVM-ST	51X-11			51X-12			51X-13		
Barometer, mm Hg	739.7	735.1	744.7	739.5	735.1	744.2	739.5	735.1	744.7
Humidity, g/kg	10.4	8.7	11.7	10.1	9.0	11.0	10.0	9.1	11.8
Temperature, °C	24.7	24.4	25.6	26.4	25.6	27.2	26.6	25.6	27.2
Total Fuel Sulfur, mg/km	33.77	33.02	34.42	25.33	24.33	25.81	22.33	21.89	22.69
Avg. Exh. Oxygen, %	4.00	3.59	4.72	3.70	3.45	3.96	3.09	2.93	3.39
Catalyst Avg. Temp., °C	483.	475.	491.	554.	543.	564.	593.	591.	594.
Catalyst Max. Temp., °C	568.	563.	572.	608.	606.	610.	623.	618.	627.
Carbon Dioxide, g/km	366.2	358.5	373.2	276.3	265.4	281.6	243.9	239.2	247.8
Fuel Cons., ℓ/100 km	15.76	15.41	16.06	11.82	11.35	12.04	10.42	10.21	10.59
Regulated Emissions									
Hydrocarbons, (THC), g/km	0.13	0.11	0.14	0.03	0.03	0.03	0.01	0.01	0.01
Carbon Monoxide, g/km	1.63	1.35	1.77	0.35	0.20	0.48	0.05	0.01	0.11
Oxides of Nitrogen, g/km	0.83	0.76	0.92	0.77	0.72	0.85	0.83	0.78	0.95
Particulates									
Total Particulates	2.01	1.35	4.67	18.43	13.66	23.39	48.33	42.84	53.71
Sulfate	0.85	0.22	1.69	12.36	8.16	16.21	27.14	0.00	40.93
Sulfate as % of TFS, %	0.84	0.22	1.69	16.36	10.55	22.21	40.76	0.00	62.33
Compound Group Totals									
Aldehydes & Ketones	2.6	0.0	6.4	2.0	0.8	4.1	0.6	0.2	2.3
Individual Hydrocarbons	69.1	60.7	75.2	24.4	22.2	26.3	9.0	7.4	10.4
Organic Sulfides	0.21	0.14	0.31	0.11	0.01	0.27	0.04	0.01	0.06
Organic Amines	0.00	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.02
Other Compounds									
Ammonia	5.05	2.24	8.51	--	--	--	--	--	--
Cyanide & Cyanogen	0.31	0.00	0.74	--	--	--	--	--	--
DMNA	--	--	--	--	--	--	--	--	--
Hydrogen Sulfide	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nickel Carbonyl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nitrous Oxide	24.12	21.45	29.65	10.65	8.38	13.81	5.51	4.92	6.11

TABLE G-1 (Cont'd). AVERAGE, MINIMUM AND MAXIMUM VALUES FOR THE UNMODIFIED CONFIGURATION
1979 Mercury Marquis with Three-Way Catalyst

	EMISSION RATE, MG/KM (Except as Noted)								
	FTP			SET			HFET		
	AVG	MIN	MAX	AVG	MIN	MAX	AVG	MIN	MAX
Test Number, PVM-ST	51X-11			51X-12			51X-13		
Aldehydes and Ketones									
Formaldehyde	2.41	0.00	6.43	1.76	0.24	4.12	1.14	0.21	2.32
Acetaldehyde	0.11	0.00	0.34	0.19	0.00	0.58	0.04	0.00	0.14
Acetone	0.01	0.00	0.04	0.03	0.00	0.10	0.00	0.00	0.00
Isobutyraldehyde	0.08	0.00	0.31	0.03	0.00	0.11	0.05	0.00	0.18
Methyl Ethyl Ketone	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Crotonaldehyde	--	--	--	--	--	--	--	--	--
Hexanaldehyde	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Benzaldehyde	--	--	--	--	--	--	--	--	--
Aldehydes and Ketones	2.6	0.0	6.4	2.0	0.8	4.1	1.2	0.2	2.3
Total as % of THC, %	1.9	0.0	4.6	6.7	2.7	13.7	12.0	2.0	23.0
Individual Hydrocarbons									
Methane	45.56	37.87	53.69	21.00	19.84	22.85	8.27	6.70	9.53
Ethylene	4.69	3.99	5.60	0.58	0.42	0.73	0.00	0.00	0.01
Ethane	4.63	4.11	5.20	1.76	1.51	2.04	0.53	0.31	0.67
Acetylene	1.58	1.24	1.84	0.00	0.00	0.00	0.00	0.00	0.00
Propane	0.63	0.30	1.14	0.03	0.00	0.11	0.13	0.00	0.51
Propylene	1.90	1.57	2.17	0.00	0.00	0.00	0.00	0.00	0.00
Benzene	4.65	4.06	5.09	0.83	0.22	1.93	0.02	0.00	0.09
Toluene	5.45	3.79	7.15	0.19	0.00	0.40	0.01	0.00	0.05
Total Individual HC	69.1	60.7	75.2	24.4	22.2	26.3	9.0	7.4	10.4
Total as % of THC, %	54.3	53.7	55.2	81.3	74.0	87.7	90.0	74.0	104.0
Organic Sulfides									
Carbonyl Sulfide	0.13	0.08	0.23	0.03	0.00	0.05	0.03	0.01	0.06
Methyl Sulfide	0.04	0.02	0.07	0.03	0.01	0.07	0.01	0.00	0.03
Ethyl Sulfide	0.02	0.01	0.02	0.03	0.00	0.10	0.00	0.00	0.00
Methyl Disulfide	0.01	0.00	0.03	0.02	0.00	0.05	0.00	0.00	0.00
Organic Amines									
Monomethylamine	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.02
Monoethylamine	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00
Trimethylamine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diethylamine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Triethylamine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE G-1 (Cont'd). AVERAGE, MINIMUM AND MAXIMUM VALUES FOR THE UNMODIFIED CONFIGURATION
1979 Mercury Marquis with Three-Way Catalyst

		EMISSION RATE, MG/KM (Except at Noted)								
		FTP			SET			HFET		
		AVG	MIN	MAX	AVG	MIN	MAX	AVG	MIN	MAX
Test Number, PVM-ST										
Other Elements										
Chromium	Cr									
Lead	Pb	0.07	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00
Manganese	Mn									
Arsenic	As									
Mercury	Hg									
Bromine	Br									
Phosphorus	P									
Silicon	Si	0.00	0.00	0.00	0.01	0.00	0.02	0.01	0.00	0.02
Cadmium	Cd									
Aluminum	Al	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Sulfur	S	0.19	0.06	0.44	4.83	2.83	6.21	7.95	0.00	11.48
Sodium	Na									
Fluorine	F									
Magnesium	Mg									
Potassium	K									
Chlorine	Cl	0.32	0.01	1.22	0.01	0.00	0.01	0.01	0.00	0.02
Platinum	Pt									
Zinc	Zn									
Copper	Cu									
Nickel	Ni									
Iron	Fe	0.12	0.04	0.18	0.04	0.03	0.06	0.00	0.00	0.00
Vanadium	V									
Titanium	Ti									
Barium	Ba	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.00	0.01
Calcium	Ca	0.01	0.00	0.01	0.01	0.00	0.02	0.01	0.00	0.02

Note: Most values of 0.00 for Other Elements have been left blank.

APPENDIX H

AVERAGE VALUES FOR ALL CONFIGURATIONS

TABLE H-1. CAR 51 AVERAGE RESULTS FOR THE UNMODIFIED AND THE MALFUNCTION CONFIGURATIONS - FTP 1979 MERCURY MARQUIS WITH THREE-WAY CATALYST

		Average Emission Rate, mg/km (Except as Noted)				
		Unmod.	Disabled O_2 Sensor	12% Misfire & Air	Disabled EGR & Air	Disc. CTS
Test No.	PVM	51	511	512	513	514
Barometer,	mm Hg	739.7	740.2	743.9	741.1	745.7
Humidity,	g/kg	10.4	10.4	11.6	11.3	9.5
Temperature,	°C	24.7	24.7	23.6	24.4	22.8
Total Fuel Sulfur,	mg/km	33.77	33.19	35.19	36.68	39.61
Avg. Exh. Oxygen,	%	4.00	3.73	0.97	0.57	0.28
Catalyst Avg. Temp.,	°C	483.	562.*	616.	400.	436.*
Catalyst Max. Temp.,	°C	568.	661.*	728.	466	527.
Carbon Dioxide,	g/km	336.2	361.0	365.3	340.6	345.0
Fuel Cons.,	ℓ/100 km	15.76	15.49	16.42	17.12	18.48
Regulated Emissions						
Hydrocarbons (THC),	g/km	0.13	0.11	1.73	1.49	1.80
Carbon Monoxide,	g/km	1.63	0.96	8.91	35.45	52.41
Oxides of Nitrogen,	g/km	0.83	2.51	0.60	0.55	0.36
Particulates						
Total Particulates		2.01	5.84	10.01	5.80	11.34
Sulfate		0.85	1.30	0.13	0.17	0.21
Compound Group Totals						
Aldehydes & Ketones		2.6	0.4	1.0	2.9	2.7*
Individual Hydrocarbons		69.1	64.6	322.9	486.6	721.9
Organic Sulfides		0.21	0.61	0.18	0.13	0.34*
Organic Amines		0.00	0.00	0.04	0.05	0.02
Other Compounds						
Ammonia		5.05	3.39	30.93	172.38	252.97
Cyanide & Cyanogen		0.31	0.13*	1.57	69.94	112.29
DMNA		--	--	--	--	--
Hydrogen Sulfide		0.00	0.00	0.59	0.35	0.96
Nickel Carbonyl		0.00	0.00	0.00	0.00	0.00
Nitrous Oxide		24.12	10.54	11.93	87.88	42.69
Aldehydes and Ketones						
Formaldehyde		2.41	0.00	0.91	1.27	0.22
Acetaldehyde		0.11	0.12	0.66	0.41	1.17
Acetone		0.01	0.00	0.00	0.15	1.10
Isobutyraldehyde		0.08	0.13	0.28	1.10	0.00*
Methyl Ethyl Ketone		0.00	0.13	0.00	0.00	0.09
Crotonaldehyde		--	--	--	--	--
Hexanaldehyde		0.00	0.00	0.00	0.00	0.00
Benzaldehyde		--	--	--	--	--

TABLE H-1 (Cont'd). CAR AVERAGE RESULTS FOR THE UNMODIFIED AND
THE MALFUNCTION CONFIGURATIONS - FTP
1979 MERCURY MARQUIS WITH THREE-WAY CATALYST

	Average Emission Rate, mg/km (Except as Notes)				
	Unmod.	Disabled O_2 Sensor	12% Misfire & Air	Disabled EGR & Air	Disc. CTS
Individual Hydrocarbons					
Methane	45.56	47.67	43.73	102.80	139.75
Ethylene	4.69	3.97	18.33	127.51	185.57
Ethane	4.63	1.96	5.24	17.23	18.95
Acetylene	1.58	1.57	2.47	3.15	3.27
Propane	0.63	0.36	1.16	0.44	2.56
Propylene	1.90	1.72	11.49	53.92	76.02
Benzene	4.65	2.42	125.43	77.98	104.69
Toluene	5.45	4.87	115.06	103.54	191.12
Organic Sulfides					
Carbonyl Sulfide	0.13	0.17	0.09	0.06	0.11*
Methyl Sulfide	0.04	0.14	0.06	0.02	0.06*
Ethyl Sulfide	0.02	0.20	0.03	0.04	0.14*
Methyl Disulfide	0.01	0.11	0.01	0.01	0.03*
Organic Amines					
Monomethylamine	0.00	0.00	0.02	0.02	0.02
Monoethylamine	0.00	0.00	0.02	0.03	0.00
Trimethylamine	0.00	0.00	0.00	0.01	0.00
Diethylamine	0.00	0.00	0.00	0.00	0.00
Triethylamine	0.00	0.00	0.00	0.00	0.00
Other Elements					
Lead	0.07	0.12	0.24	0.10	0.00
Mangenese	0.00	0.00	0.00	0.00	0.00
Bromine	0.00	0.00	0.00	0.00	0.00
Phosphorus	0.00	0.00	0.01	0.00	0.01
Silicon	0.00	0.00	0.00	0.01	0.00
Cadmium	0.00	0.00	0.00	0.00	0.00
Aluminum	0.01	0.02	0.02	0.02	0.04
Sulfur	0.19	0.03	0.04	0.53	0.06
Chlorine	0.32	0.03	2.26	0.02	0.05
Zinc	0.00	0.00	0.01	0.02	0.01
Copper	0.00	0.00	0.02	0.00	0.00
Iron	0.12	0.10	0.50	0.53	0.25
Barium	0.01	0.02	0.02	0.02	0.03
Calcium	0.01	0.01	0.01	0.03	0.01

*Validity of the average value given is questionable.

TABLE H-2. CAR 51 AVERAGE RESULTS FOR THE UNMODIFIED AND THE MALFUNCTION CONFIGURATIONS - SET 1979 MERCURY MARQUIS WITH THREE-WAY CATALYST

		Average Emission Rate, mg/km (Except at Noted)				
		Unmod.	Disabled O_2 Sensor	12% Misfire & Air	Disabled EGR & Air	Disc. CTS
Test No.	PVM	51	511	512	513	514
Barometer,	mm Hg	739.5	740.4	743.9	741.1	746.3
Humidity,	g/kg	10.1	10.8	12.1	9.5	7.9
Temperature,	°C	26.4	25.6	25.0	24.4	23.4
Total Fuel Sulfur,	mg/km	25.33	24.94	25.31	26.72	27.87
Avg. Exh. Oxygen,	%	3.70	3.89	0.58	0.36	0.22
Catalyst Avg. Temp.,	°C	554.	617.*	725.	516.	521.
Catalyst Max. Temp.,	°C	608.	715.*	784.	591.	599.
Carbon Dioxide,	g/km	276.3	272.1	271.0	272.7	244.7
Fuel Cons.,	ℓ/100 km	11.82	11.64	11.81	12.47	13.00
Regulated Emissions						
Hydrocarbons (THC),	g/km	0.03	0.04	0.35	0.45*	1.05
Carbon Monoxide,	g/km	0.35	0.23	2.93	11.45*	36.06
Oxides of Nitrogen,	g/km	0.77	2.70	0.44	0.75*	0.26
Particulates						
Total Particulates		18.84	4.13	3.75	5.75	5.49
Sulfate		12.36	2.11	0.06	0.13	0.11
Compound Group Totals						
Aldehydes & Ketones		2.0	0.2	0.6	0.7	0.6
Individual Hydrocarbons		24.4	27.0	93.9	195.6	463.2
Organic Sulfides		0.11	0.28	0.04	0.03	0.15
Organic Amines		0.01	0.00	0.01	0.02	0.01
Other Compounds						
Ammonia		--	--	--	--	--
Cyanide & Cyanogen		--	--	--	--	--
DMNA		--	--	--	--	--
Hydrogen Sulfide		0.00	0.12	0.51	0.71	2.00
Nickel Carbonyl		0.00	0.00	0.00	0.00	0.00
Nitrous Oxide		10.65	7.97	4.80	37.34	17.12
Aldehydes and Ketones						
Formaldehyde		1.76	0.03	0.12	0.63	0.01
Acetaldehyde		0.19	0.14	0.21	0.16	0.36
Acetone		0.03	0.00	0.00	0.08	0.23
Isobutyraldehyde		0.03	0.05	0.23	0.18	0.00
Methyl Ethyl Ketone		0.00	0.07	0.00	0.00	0.00
Crotonaldehyde		--	--	--	--	--
Hexanaldehyde		0.00	0.00	0.00	0.00	0.00
Benzaldehyde		--	--	--	--	--

TABLE H-2 (Cont'd). CAR 51 AVERAGE RESULTS FOR THE UNMODIFIED AND
THE MALFUNCTION CONFIGURATIONS - SET
1979 MERCURY MARQUIS WITH THREE-WAY CATALYST

	Average Emission Rate, mg/km (Except as Noted)				
	Unmod.	Disabled O_2 Sensor	12% Misfire & Air	Disabled EGR & Air	Disc. CTS
Individual Hydrocarbons					
Methane	21.00	23.71	13.70	45.74	84.19
Ethylene	0.58	1.08	6.30	41.28	111.62
Ethane	1.76	0.88	2.34	8.87	12.65
Acetylene	0.00	0.00	0.00	0.00	0.00
Propane	0.03	0.02	0.63	0.78	1.24
Propylene	0.00	0.17	6.00	19.75	52.18
Benzene	0.83	0.56	48.95	41.29	79.33
Toluene	0.19	0.53	15.94	37.84	122.02
Organic Sulfides					
Carbonyl Sulfide	0.03	0.15	0.03	0.02	0.09
Methyl Sulfide	0.03	0.14	0.02	0.01	0.05
Ethyl Sulfide	0.03	0.00	0.00	0.00	0.01
Methyl Disulfide	0.02	0.00	0.00	0.00	0.01
Organic Amines					
Monomethylamine	0.00	0.00	0.00	0.02	0.01
Monoethylamine	0.00	0.00	0.01	0.00	0.00
Trimethylamine	0.00	0.00	0.00	0.00	0.00
Diethylamine	0.00	0.00	0.00	0.00	0.00
Triethylamine	0.00	0.00	0.00	0.00	0.00
Other Elements					
Lead	0.00	0.07	0.09	0.00	0.08
Manganese	0.00	0.00	0.00	0.00	0.00
Bromine	0.00	0.00	0.02	0.00	0.00
Phosphorus	0.00	0.00	0.00	0.00	0.01
Silicon	0.01	0.00	0.00	0.01	0.01
Cadmium	0.00	0.00	0.00	0.00	0.00
Aluminum	0.00	0.01	0.00	0.01	0.01
Sulfur	4.83	0.05	0.03	0.94	0.03
Chlorine	0.01	0.46	1.78	0.02	0.09
Zinc	0.00	0.00	0.00	0.00	0.00
Copper	0.00	0.00	0.00	0.00	0.00
Iron	0.04	0.10	0.22	0.05	0.09
Barium	0.01	0.01	0.01	0.00	0.01
Calcium	0.01	0.01	0.00	0.01	0.01

*Validity of the average value given is questionable.

TABLE H-3. CAR 51 AVERAGE RESULTS FOR THE UNMODIFIED AND THE MALFUNCTION CONFIGURATIONS - HFET
1979 MERCURY MARQUIS WITH THREE-WAY CATALYST

		Average Emission Rate, mg/km (Except at Noted)				
		Unmod.	Disabled O_2 Sensor	12% Misfire & Air	Disabled EGR & Air	Disc. CTS
Test No.	PVM	51	511	512	513	514
Barometer,	mm Hg	739.5	740.8	743.9	742.6	746.3
Humidity,	g/kg	10.0	9.9	11.5	9.3	8.0
Temperature,	°C	26.6	27.5	24.8	25.0	23.9
Total Fuel Sulfur,	mg/km	22.33	20.99	22.93	24.20	25.65
Avg. Exh. Oxygen,	%	3.09	1.35	0.30	0.25	0.08
Catalyst Avg. Temp.,	°C	593.	606.*	774.	631.	578.
Catalyst Max. Temp.,	°C	623.	636.*	790.	644.	616.
Carbon Dioxide,	g/km	243.9	229.4	248.9	263.2	226.8
Fuel Cons.,	ℓ/100 km	10.42	9.80	10.70	11.30	11.97
Regulated Emissions						
Hydrocarbons (THC),	g/km	0.01	0.01	0.10	0.08	0.85
Carbon Monoxide,	g/km	0.05	0.05	1.00	0.76	32.41
Oxides of Nitrogen,	g/km	0.83	1.28	0.42	0.97	0.21
Particulates						
Total Particulates		48.43	9.93	0.89	2.11	2.57
Sulfate		27.14	5.19	0.07	0.14	0.06
Compound Group Totals						
Aldehydes & Ketones		0.6	0.1	1.3	0.9	1.0
Individual Hydrocarbons		9.0	8.72	29.4	27.4	383.2
Organic Sulfides		0.04	0.81	0.06	0.03	0.20
Organic Amines		0.01	0.00	0.02	0.01	0.02
Other Compounds						
Ammonia		--	--	--	--	--
Cyanide & Cyanogen		--	--	--	--	--
DMNA		--	--	--	--	--
Hydrogen Sulfide		0.00	0.00	0.13	0.40	3.18
Nickel Carbonyl		0.00	0.00	0.00	0.00	0.00
Nitrous Oxide		5.51	4.24	2.44	7.61	8.88
Aldehydes and Ketones						
Formaldehyde		1.14	0.00	0.22	0.38	0.02
Acetaldehyde		0.04	0.00	0.13	0.08	0.00
Acetone		0.00	0.00	0.00	0.16	0.00
Isobutyraldehyde		0.05	0.00	0.90	0.20	0.95
Methyl Ethyl Ketone		0.00	0.12	0.00	0.00	0.00
Crotonaldehyde		--	--	--	--	--
Hexanaldehyde		0.00	0.00	0.00	0.00	0.00
Benzaldehyde		--	--	--	--	--

TABLE H-3 (Cont'd). CAR 51 AVERAGE RESULTS FOR THE UNMODIFIED AND THE MALFUNCTION CONFIGURATIONS - HFET 1979 MERCURY MARQUIS WITH THREE-WAY CATALYST

	Average Emission Rate, mg/km (Except as Noted)				
	Unmod.	Disabled O_2 Sensor	12% Misfire & Air	Disabled EGR & Air	Disc. CTS
Individual Hydrocarbons					
Methane	8.27	10.09	4.21	8.38	72.13
Ethylene	0.00	0.04	3.41	2.61	93.53
Ethane	0.53	0.81	1.19	2.19	11.77
Acetylene	0.00	0.00	0.00	0.00	0.00
Propane	0.13	0.02	0.20	0.00	1.05
Propylene	0.00	0.00	3.66	2.09	47.34
Benzene	0.02	0.22	13.88	8.06	68.86
Toluene	0.01	0.10	2.79	4.06	88.55
Organic Sulfides					
Carbonyl Sulfide	0.03	0.26	0.03	0.03	0.08
Methyl Sulfide	0.01	0.26	0.03	0.01	0.06
Ethyl Sulfide	0.00	0.05	0.00	0.00	0.03
Methyl Disulfide	0.00	0.24	0.00	0.00	0.03
Organic Amines					
Monomethylamine	0.01	0.00	0.01	0.01	0.02
Monoethylamine	0.00	0.00	0.02	0.00	0.00
Trimethylamine	0.00	0.00	0.00	0.00	0.00
Diethylamine	0.00	0.00	0.00	0.00	0.00
Triethylamine	0.00	0.00	0.00	0.00	0.00
Other Elements					
Lead	0.00	0.00	0.25	0.00	0.00
Manganese	0.00	0.00	0.00	0.00	0.00
Bromine	0.00	0.00	0.00	0.00	0.00
Phosphorus	0.00	0.00	0.00	0.01	0.00
Silicon	0.01	0.00	0.00	0.00	0.00
Cadmium	0.00	0.00	0.00	0.00	0.00
Aluminum	0.00	0.01*	0.00	0.01	0.00
Sulfur	7.95	0.05*	0.01	2.05	0.01
Chlorine	0.01	0.41*	1.65	0.02	0.02
Zinc	0.00	0.00	0.00	0.00	0.00
Copper	0.00	0.00	0.00	0.00	0.00
Iron	0.00	0.08*	0.05	0.20	0.02
Barium	0.01	0.01*	0.01	0.01	0.01
Calcium	0.01	0.00	0.00	0.01	0.00

*Validity of the average value given is questionable.